Rumination and co-rumination as moderators of the relationship between stress and depressive symptoms: examining different domains of life events and hassles [volume 1: a systematic literature review; volume 2: main research project]

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SYSTEMATIC LITERATURE REVIEW
&
MAIN RESEARCH PROJECT

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Systematic Literature Review

THE ROLE OF RUMINATION IN THE LONGITUDINAL RELATIONSHIP BETWEEN STRESS AND DEPRESSIVE SYMPTOMS

Supervised by Dr Patrick Smith and Dr Eleanor Leigh

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Abstract

There is a sharp rise in prevalence rates of depressive symptoms and depressive disorders during adolescence. Given that depression and depressive symptoms during adolescence are associated with impaired functioning in several areas of life and continuity into adulthood, a key priority for research is to understand the risk factors for depressive disorders during this period. Rumination, defined as passively and repetitively focusing attention on one's own depressive symptoms and on understanding their causes and consequences, has been consistently associated with prospective symptoms of depression in adults and youth, in clinical and community populations. In the last decade researchers have begun to explore vulnerability-stress models of depression, examining rumination in response to stressful events. The current review sought to identify and evaluate studies that explore rumination as a moderator or mediator of the relationship between stressors and prospective depressive symptoms.

A systematic search for relevant articles of three databases (Embase, Medline and Psychinfo) was conducted in line with PRISMA guidance. Seventeen studies were included in the review and a qualitative synthesis of the results was produced. Fourteen studies explored rumination as a moderator and three studies tested rumination as a mediator. There was mixed support for rumination as a moderator of the longitudinal stressor-depressive symptom association in adolescents. Although all studies rated as 'good' quality found a significant moderating effect of rumination. Whereas studies rated as 'fair' quality demonstrated mixed findings. There was a lack of evidence for rumination as a mediator of the stressor-prospective depressive symptoms association in adolescents. Further research into rumination as a mediator of the stressor-depressive symptoms relationship is necessary for conclusions to be drawn. Limitations and clinical and research implications of the findings are discussed.

1. **Introduction**

Epidemiological data points to the transitions from childhood through adolescence to adulthood as critical for understanding the development of depression. Firstly, there is a sharp rise in prevalence rates of depressive symptoms and depressive disorders during adolescence. Point prevalence rates of depressive episodes rise from 1-3% for those under the age of 13 to 10 % by age 18 (Costello, Erkanli & Angold, 2006). Furthermore, it is during adolescence that a gender difference in prevalence rates begins to emerge. Prior to adolescence, there is no significant gender difference in prevalence rates of depression, but around age 13 girls' rates of depressive symptoms and depressive episodes increase, while boys' remain fairly stable. By the end of adolescence girls are approximately twice as likely to be diagnosed with depression and report twice as many symptoms (Girgus & Yang, 2015).

Not only is depression in youth associated with impaired functioning in several areas of life, including emotional, educational and interpersonal problems (Avenevoli, Knight, Kessler, & Merikangas, 2008; Fergusson & Woodward, 2002), but it often continues into adulthood, with the majority of depressed adults experiencing their first clinically significant episode of depression during mid- to late- adolescence (Abela & Hankin, 2008). Given the negative associations with adolescent depression, it is essential that we understand the risk factors for depressive disorders and symptoms during this period, in order for preventative interventions to be developed to target these risk factors.

The Response Styles Theory (RST; Nolen-Hoeksema, 1991) proposes that the way people tend to respond to depressed or sad mood may be one factor that increases the likelihood of developing depression. Two such responses are proposed: rumination and distraction. In Nolen-Hoeksema's conceptualization of rumination, it is a "mode of responding to distress that involves repetitively and passively focusing on symptoms of distress and on the possible causes and consequences of these symptoms" (Nolen-Hoeksema, Wisco & Lyubomirsky, 2008, p400). Rumination appears to be consistent across situations and time and is hence conceptualised as a stable, trait-like way of responding to depressed or sad mood (Nolen-Hoeksema, Morrow & Fredrickson, 1993). Nolen-Hoeksema (1991) posits that individuals who ruminate in response to depressed mood are likely to experience increased duration and severity of symptoms, where as those who use distraction are more likely to experience relief from symptoms. The RST suggests that the gender difference in depression rates could be, at least partly, explained by the differential tendencies towards rumination versus distraction in women and men. According to the RST, women are more likely to use rumination and men more likely to use distraction in response to depressive feelings.

Many studies have tested the hypotheses of the RST and provide support for an association between rumination and depression. Experimental studies using induction designs to manipulate rumination or distraction, support the hypothesis that rumination increases dysphoric mood relative to distraction, provided the individual is in a sad mood at the time just prior to rumination induction. In cross-sectional, correlational studies rumination is found to be elevated in currently and formerly depressed patients and in women relative to men and is associated with higher concurrent depressive symptoms. Evidence from prospective longitudinal studies demonstrates that people who tend to ruminate in response to distress, have more prolonged periods of depression, are more likely to develop depressive disorders, and experience increased depression symptoms over time, after accounting for baseline levels of depressive symptoms (for reviews see Nolen-Hoeksema et al., 2008; Watkins, 2008; Thomsen, 2006; Lyubomirsky & Tkach, 2004).

Studies have also examined the depression-rumination association in children and adolescents. Results of a meta-analysis conducted by Rood, Roelofs, Bögels, Nolen-Hoeksema and Schouten (2009) suggest that rumination is moderately associated with cross-sectional and prospective depressive symptoms in non-clinical samples of adolescents. The effects remain significant but modest when controlling for baseline depressive symptoms.

Most of the research into the RST has focussed on the direct relationship between rumination and depression. In the last decade however, researchers have increasingly examined the RST within a cognitive vulnerability-stress framework. Cognitive vulnerability-stress models propose that individuals with cognitive vulnerabilities are more likely to become depressed than nonvulnerable individuals following the occurrence of negative events (Hankin & Abramson, 2001).

Within a cognitive vulnerability-stress framework, rumination would be expected to exacerbate the effects of stress on later symptoms of depression, such that those with higher levels of rumination would be more likely to develop depression following stressful events. Cognitive vulnerability-stress models conceptualise rumination as a condition that affects the strength of the association between stressful events and depressive symptoms. More specifically, rumination is conceptualised as a moderator of the stress-depression relationship (as represented in Figure 1). Moderators are variables which affect the size or direction of the effect between two variables (Hayes & Rockwood, 2017).

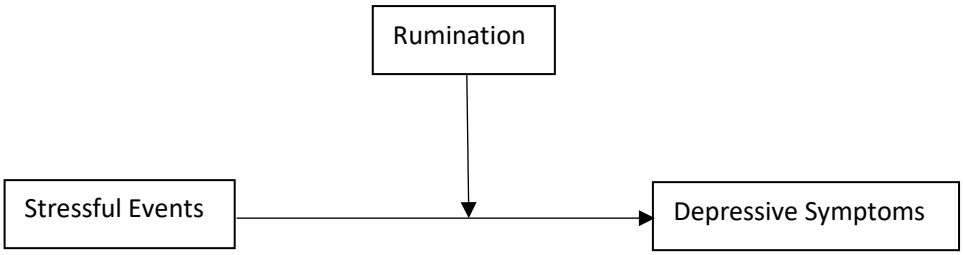

Figure 1: Moderation model for rumination as a moderator of the relationship between stress and depressive symptoms.

Control Theories (see Watkins, 2008 for review) suggest that the occurrence of negative life events might lead to increases in rumination following the occurrence of negative events. The occurrence of a negative event is theorised to create a discrepancy between the person's goals, desired outcomes or standards and their current situation. Control theories propose that rumination is triggered by a discrepancy between actual state and desired goal and will continue until the goal is met or the individual disengages from the goal, the aim of rumination being to facilitate progress towards reducing the discrepancy between actual and desired states (Watkins 2008). Increases in rumination following negative events are then predicted to lead to increased depressive symptoms (Michl, McLaughlin, Shepherd & Nolen-Hoeksema, 2013). From this perspective rumination would be considered a mediator of the stress-depression relationship, where the relationship between stress and later depressive symptoms can be explained (or at least partially explained) by increases in stressful life events predicting increases in rumination, which in turn predicts increases in depressive symptoms over time.

Baron and Kenny (1986) describe a set of criteria required to establish mediation, using regression analyses (as represented by Figure 2). Relating their criteria to the current question regarding rumination as a mediator of the association between negative life events and depression, the first criterion is that negative events must be statistically significantly related to depressive symptoms. The second criterion is that stress is significantly associated with rumination. Thirdly, rumination must be significantly associated with depressive symptoms, when controlling for stress. If all these criteria are met then the final criterion for establishing a mediation effect is that the relationship between stress and depression is significantly closer to zero, when controlling for rumination, than when not controlling for rumination.

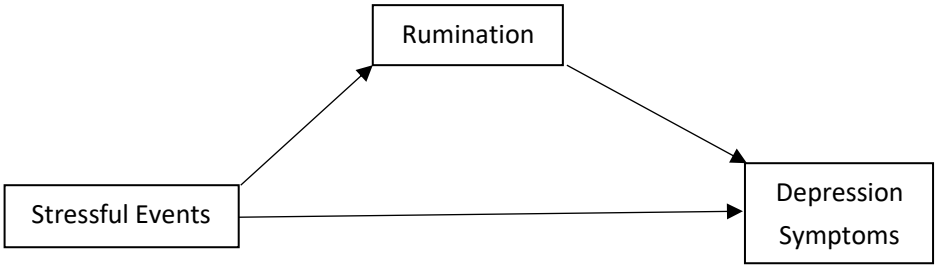

Figure 2: Mediator model for rumination as a mediator of the relationship between stressful events and depressive symptoms.

In summary, there has been a recent increase in the number of studies examining the role of rumination in the relationship between stressful events and changes in depressive symptoms over time in adolescents. However, so far there has been no systematic review of the research in this area. If the research suggests that rumination is found to exacerbate the effects of stress on depression symptoms in adolescents, or is one route via which stress effects depression, then it may be an important target for preventative interventions. The current review aims to provide a systematic search of studies that examine rumination as a mediator or moderator of the association between stressful events and depression in adolescents, with the aim of providing a qualitative synthesis of the results of included studies and evaluating the quality of the current literature base before discussing clinical implications of the results and recommendations for future research. The review will focus on the following two questions:

1) Does rumination moderate the association between stressful events and depressive symptoms over time?
2) Does rumination mediate the association between stressful events and depressive symptoms over time?

1. Method.

2.1 Design and Registration

A systematic search of databases was conducted to identify relevant studies. Studies for inclusion in the review were selected using pre-defined inclusion and exclusion criteria and a qualitative synthesis of the results provided.

The review was registered on the PROSPERO register, record CRD42017057509.

2.2 Search Strategy

Three databases were used to conduct a search for potentially relevant studies, Embase, Medline and Psychinfo. Reference lists of studies included in the review were also visually inspected to identify any further relevant journal articles. The final search took place on 12th January 2018.

2.3 Eligibility

Studies were included in the review if they were:

- Written in English
- Published in a peer-reviewed journal
- Measure rumination, stressful events or hassles and depressive symptoms.
- Longitudinal design.
- Child or adolescent sample, (19 years old or younger).
- Examined rumination as a mediator or moderator of the relationship between stressors and depressive symptoms.
- Type of rumination measured included depressive rumination, rumination in response to sadness, rumination in response to stress, or were subscales of depressive rumination (e.g. brooding and/or reflection).

Studies were excluded from the review if they were:

- Not written in English
- Dissertations, theses, case studies, reviews or book chapters
- Cross-sectional design (excluded because it is not possible to infer the direction of the relationship between stressors, rumination and depression from cross-sectional studies).
- Adult sample
- Examined stressors that were related to a specific traumatic event
- Examining other types of rumination or repetitive thought, e.g. worry, anger-rumination, co-rumination.
- Intervention studies.

2.4 Search Terms

The following search terms were used:

"ruminat*" OR "response style*" OR "brooding" OR "repetit* thought" OR "repetit* think*" AND "stress*" OR "negative life event*" OR "hassle*" OR "daily hassle*" OR "life event*" OR "negative event*" AND "depress*" OR "dysphori*" OR "depress* symptom*" AND "adolescen*" OR "child*" OR "youth" OR "young" OR "early adolescen*" OR "mid* adolescen*" OR "late adolescen*".

Where appropriate Medical Subject Heading (MESH) terms existed, these were also included in the search to minimise the risk of relevant studies not being identified. Appendices 1, 2 and 3 display full search strategies used for Embase, Medline and Psychinfo respectively.

2.5 Selection Process and data extraction

Search results, including titles and abstracts were exported to a reference management software (EndNote X8) and duplicates were removed. Titles and abstracts were screened for potentially relevant studies by one of the reviewers (AL). Irrelevant studies or studies that met exclusion criteria were excluded from the review. Full text articles were obtained for the remaining references. The full-text articles were screened (AL) and eligible studies included in the final synthesis. Two queries arose as to whether studies met inclusion/exclusion criteria. These were discussed with the lead researchers (EL and PS) until agreement was reached.

Data in the following fields was extracted from included studies: author name, publication date, age range/mean age, country, sample size, gender proportion, design, measurement methods for predictor and outcome variables, analyses and results. See Table 1 and Appendix 5**Error! Reference source not found.** for data extracted from included articles.

2.6 Methodological Quality Assessment

As recommended by the PRISMA Statement for reporting of systematic reviews (Moher, Liberati, Tetzlaff, Altman & Prisma Group, 2009), the methodological quality of each study included in the review was assessed to evaluate the degree to which included studies had minimized key sources of bias and error which might exaggerate or underestimate the effects. In the current review, The Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (National Institute of Health, 2014; see Appendix 4) was used to assess the methodological quality of the included articles. This measure was chosen because it was specifically designed to assess the quality of observational studies and hence the items

were relevant to the current review question. The quality assessment tool examines methodological quality in the areas of research aims, study population & generalisability, reliability and validity of measures of predictors and outcomes, study design, data analyses and study attrition. The ratings on the different items of the tool are used by the reviewer to assess the risk of bias in the study and judge the quality of the study as either "good", "fair", or "poor". A "good" study has a low risk of bias and error and results are regarded as valid. "Fair" studies contain some bias but not to a level that would be considered sufficient to invalidate the results. Finally, a "poor" rating indicates significant risk of bias.

The methodological quality assessment of included studies was conducted by one of the researchers (AL) on all studies, and five of the studies (29.4%) were randomly selected and reviewed independently by another researcher (RM). The strength of the agreement on the independent ratings between the two assessors was 80%. If the ratings differed, discrepancies were resolved through discussion.

2. Results

3.1 Selection of Studies

The database search resulted in 802 studies, of which 294 were duplicates. Five-hundred-and-nine records were screened using the title and abstract, 324 of which were excluded because they did not meet inclusion criteria, resulting in 186 full-text articles assessed for eligibility. One-hundred-and-sixty-nine of the full text articles assessed for eligibility were excluded, resulting in 17 studies being included in the data extraction, quality assessment and qualitative synthesis of results. Fourteen studies were identified that examined rumination as a moderator of the longitudinal relationship between stressors and depressive symptoms in adolescents and 3 studies were identified that examined rumination as a mediator of the stressor-depressive symptoms relationship. Figure 3 displays the selection process for this review, including the number of articles excluded at each stage and the reasons for exclusion.

3.2 Characteristics of Studies

Table 1 displays a summary of the characteristics for each study.

3.2.1 Sample

Participants were recruited from a variety of countries: USA (8), Canada (3), Spain (2) Canada & USA (1), Portugal (1), Belgium (1), Not reported (1). All 17 studies used community samples.

A total of 7078 participants were included across all studies included in the review. The sample sizes of the studies ranged from 56 (Abela, Hankin, Sheshko, Fishman, & Stolow, 2012) to 1065 (Michl et al., 2013).

There was generally a slightly higher proportion of female participants. Overall 54.5% of the participants included in the whole review were female. The lowest proportion of females was 44.64% (Abela, Hankin, Sheshko, Fishman & Stolow, 2012) and the highest 78.20% (Abela, Parkinson, Stolow & Starrs, 2009).

The age of the adolescents included in this review ranged from 7 to 19 years. Eight Studies included participants in the earlier stages of adolescence (10 – 14 years), one study included children and early adolescents (7 – 14-year olds), two studies included participants in later adolescence (15 – 19 years), whilst four studies included participants that fell across the middle of these two groups (12 -17 years). Two studies included participants from across the whole age-range of adolescence.

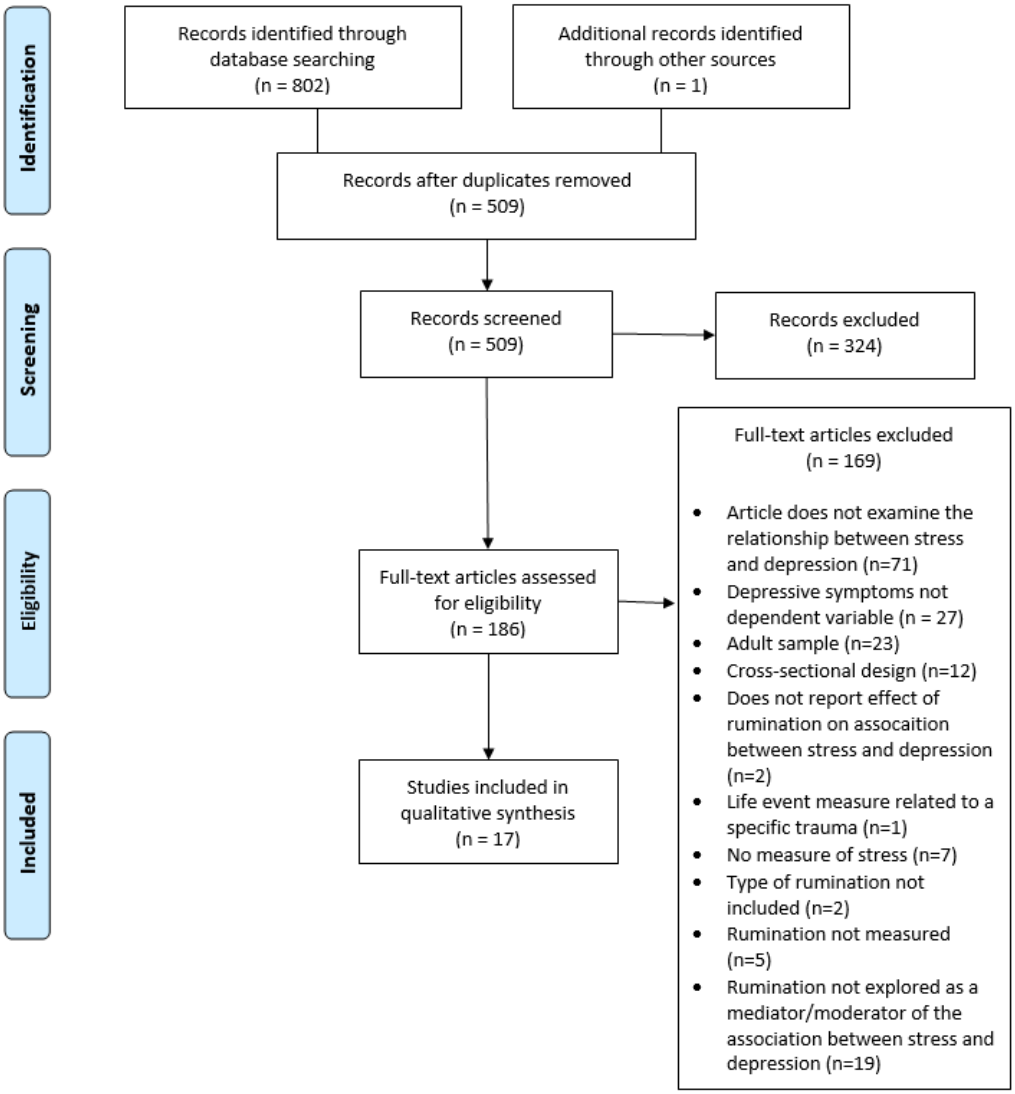

Figure 3: Preferred Reporting Items for Systematic Reviews and Meta Analyses (PRISMA) Flowchart of selected studies.

Table 1: Study Characteristics of Included Studies

Author	Year	Age Range	Country	N	Gender proportions	Design and data collection period
Abela, J. R. and B. L. Hankin	2011	11 - 15 years, M = 12.58, SD = 1.09	Canada & USA	382	225 girls, 157 boys	2 year, multi-wave, longitudinal. T1 = baseline depressive symptoms, rumination. T2 = negative events and depressive symptoms collected every 3 months for 2 years (8 waves), onset of major depressive episodes measured every 6months for two years (4 waves).
Abela, J. R., et al.	2012	7 to 14 years, M=10.6 years	Canada	56	25 girls, 31 boys	8 week, multi-wave, longitudinal. T1 = baseline rumination and depressive symptoms. T2 = hassles and depressive symptoms every 5-9 days over 8 week period, total of 6 assessments over the follow-up period.
Abela, J. R., et al.	2009	9th Grade, M = 14.3 years (SD = 1.34).	Canada	367	287 girls, 80 boys	Longitudinal, 2 time-points. T1 = depressive symptoms, rumination. Follow-up (6 weeks later) = depressive symptoms & negative events.
Arnarson, E. O., et al.	2016	12–16 years (M=13.65, SD = 1.43)	Portugal	182	130 females (71.4 %) and 52 males (28.6 %)	Longitudinal, two time-points. T1 = Depressive symptoms, Emotion regulation, including rumination, Life Events, Brooding & Reflection. T2 = same measures 12 months later.
Bastin, M., et al.	2015	9.42 to 15.00 years	Belgium.	368	63.0% girls	Longitudinal, 4 time-points. T1 = brooding, depressive symptoms and Life events. Stress and depressive symptom measures repeated at 3, 8 and 12 months.

Author	Year	Age Range	Country	N	Gender proportions	Design and data collection period
		(M=11.72; SD=1.10)				
Bijttebier, P., et al.	2012	10.17 - 14.08 years, (M= 11.75 years, SD 1.06)	Not Reported.	345	62.5% girls	Longitudinal, 2 time points. T1 = depressive symptoms, brooding, reflection, (and other response styles not relevant to this review), life events. T2 (3 months later) = depressive symptoms, life events.
Calvete, E., et al.	2015	M = 13.42 years (SD = 1.30)	Spain	1000	455 girls and 545 boys	Longitudinal, 3 time points. T1 (beginning of school year) = depressive symptoms, stressful life events, rumination. Same measures collected at T2 (6 months later) and T3 (12 months later).
Cohen, J. R., et al.	2014	NR age. Report grades: 3rd, 6th & 9th grades.	USA	678	380 females; 298 males	Multi-wave, longitudinal (over 18 months) study. T1: rumination, stressors, anxiety and depressive symptoms. Phase 2 (every 3 months for 18 months, 6 follow-up assessments) depressive symptoms, anxiety symptoms and stressors.
Cox, S., et al.	2012	14.08 to 19.33 years (mean =16.40, SD =1.33).	USA	111	80 female	Multi-wave, 3 month prospective study. T1= trait rumination and depressive symptoms. Follow up = weekly diary assessment each week for 8 weeks, and again at 12 weeks (9 weekly diary assessments across 12 weeks) = stressors experienced that week and current depressive symptoms.

Author	Year	Age Range	Country	N	Gender proportions	Design and data collection period
Driscoll, K. A., et al.	2009	4^{th} – 7^{th} Grades, M = 10.67 years; SD = 1.85	USA	202	1:1	Longitudinal, 2 time points over 8 months. T1 = depressive symptoms, response styles & stressors, T2 (8 months later) = same measures.
Hamlat, E. J., et al.	2015	12–13 years, M = 12.44 years, SD = 0.63	USA	160	56.2% male	Longitudinal, 2 time points. T1, self-report = current depressive symptoms, rumination, Mother report= stressful life-time events prior to T1. Follow up (9 months later), self-report = current depressive symptoms and stressful life events between T1 and T2.
Hankin, B. L.	2009	11 to 17 years (M=14.5, SD=1.40)	USA	350	57% female	Longitudinal, 4 time points over 5-month period, approximately 5 weeks between each time point. T1 = depressive symptoms, rumination, baseline life events. T2 & T3 = depressive symptoms. T4= depressive symptoms, Life events since T1.
Michl, L. C., et al.	2013	M = 12.2 years, SD = 1.0	USA	1065	51.2% boys and 48.8% girls	Longitudinal, 3 time points across 7 months. T1 = stressful life events, rumination, depression, anxiety, T2 = rumination, T3 = stressful life events, rumination, depression, anxiety.
Paredes, P. P., & Zumalde, E. C.	2015	13 – 17 years (M= 13.42, SD = 1.30)	Spain	998	T1 = 45% girls, 55% boys. T2 &	Longitudinal with 3 time points, spaced 6 months apart. T1 = rumination, stress and depression symptoms T2 & T3 = stress and depression

Author	Year	Age Range	Country	N	Gender proportions	Design and data collection period
					T3 = 471 girls : 526 boys	
Schwartz, J. A. J. and L. J. Koenig	1996	14 - 18 years (M=15.99, SD = 1.15)	USA	397	152 males, 245 females.	Longitudinal, 3 time point. T1 = Depressive symptoms, response styles, life events. T2 (4 weeks later) = Life events, T3 (2 weeks after T2) = Depressive symptoms and life events for the 2 weeks since last assessment.
Skitch, S. A. and J. R. Abela	2008	12 - 18 years (M = 15.17, SD = 1.22)	Canada	161	46% male, 54% female	Longitudinal multi-wave. T1 = rumination, depressive symptoms, substance misuse. Every 6 weeks for 18 weeks = dep symptoms & occurrence of negative life events.
Stange, J. P., et al.	2014	12 -13 years. (M=12.32, SD=0.61)	USA	256	54% female	Longitudinal, 2 time point. Baseline = depression, response styles. Follow-up (9 months later) = depression, life events since baseline.

Note: N = sample size, M = Mean, SD = Standard Deviation, T = time point

3.2.2 Design

Of the 14 studies that examined whether rumination moderates the relationship between stressors and longitudinal depressive symptoms, 12 studies comprised baseline assessment of depressive symptoms and rumination/response styles (among other variables) with a varying number of follow-up assessments. Follow up assessments included measures of stressors and depressive-symptoms at each follow-up wave. The varying number of waves of follow-up assessment were one (seven studies), two (one study), six (two studies), eight (one study) and nine (one study). One study measured stressors, rumination, anxiety and depression at baseline, followed by rumination measured at Time point 2 and all measures repeated at Time point 3 (Michl et al, 2013). Another study (Hankin, 2009), measured baseline depressive symptoms, rumination and life events, then measured depressive symptoms at three follow-up assessments, with life events since baseline also measured at the final assessment. The studies examining whether rumination mediates the relationship between stressors and longitudinal depressive symptoms had two (one study) or three (two studies) waves.

The duration of follow-up period for the studies examining rumination as a moderator of the stress-depressive symptoms association ranged from six weeks (Abela et al., 2012) to two years (Abela & Hankin, 2011). The studies that examined rumination as a mediator of the stress-depressive symptoms association had follow-up periods of 7 months or 12 months (2 studies).

3.2.3 Measurement of Depression

Of the studies included, 12 used The Children's Depression Inventory (CDI; Kovacs, 1985) to measure depressive symptoms. The CDI is a widely used self-report measure of depressive symptoms, which has demonstrated good reliability and validity (Klein, Dougherty & Olino, 2005). It consists of 27 items, rated on a scale from 0 (no problem) to 2 (severe problem), that are summed to create a total score. One study used the Portuguese version of the CDI, which has shown high internal consistency (Marujo, 1994).

The Centre for Epidemiologic Studies Depression Scale (CES-D, Radloff 1977) was also used by three studies as a self-report measure of depressive symptoms. Two of these used the Spanish version of the CES-D (Calvete & Cardeñoso, 1999). The CES-D contains 20 items representing depressive symptoms, which are rated on a scale from 0 to 3. The rating period used by these studies ranged from one week to one month. The CES-D has demonstrated good reliability and validity (Roberts, Andrews, Lewinsohn, & Hops, 1990; Phillips et al., 2006).

One study used The Beck Depression Inventory (BDI; Beck, Ward, Mendelson, Mock & Erbaugh, 1961), a 21 item self-report questionnaire that assesses depressive symptoms. It is a widely used measure and displays adequate reliability and validity (Beck, Steer & Carbin, 1988).

Abela & Hankin, (2011) used a clinician rated severity score from the K-SADS (Kaufman, Birmaher, Brent, Rao & Ryan, 1996) as-well as the adolescent self-report on the CDI. The K-SADS is a semi-structured clinical; interview for the diagnosis of mental disorders as defined by the Diagnostic and Statistical Manual of mental Disorders (4th ed.; DSM-IV). In Abela and Hankin (2011) the K-SADS was based on both adolescent and parent reports.

3.2.4 Measurement of Stressors

All of the studies used events checklists to measure stressors. Twelve studies used retrospective self-report checklists of negative life events. The Adolescent Life Events Questionnaire (ALEQ; Hankin & Abramson, 2002) was the most frequently used measure of life events, used by ten studies. The ALEQ uses 63 events, covering a broad range of stressors reported by adolescents, including school, relationship, peer and family problems. Reliability and validity have been demonstrated for the ALEQ (Hankin, 2008a; Hankin & Abramson, 2002; Hankin, Stone & Wright, 2010).

However, there was considerable variation across the studies utilising the ALEQ with regard to the number of items, the time period over which events were recalled and whether the events were rated according to frequency (e.g on a five-point scale) or whether a dichotomous 'yes' or 'no' response was used to indicate whether the event had occurred or not during the time-period. In four of these studies participants were asked to rate the frequency with which each

event occurred on a five-point scale ranging from 'never' to 'always'. Whereas five of the studies using the ALEQ asked participants to indicate whether the event had occurred, using a dichotomous 'yes' or 'no' response, over the time period. One study asked participants to indicate whether the event had occurred and then to rate the degree of stress related to the event on a scale from 0, 'not at all stressful' to 3 'very stressful'. The number of items used from the ALEQ varied from 40 to 63. Studies used varying time periods for rating of life events of one month (2 studies), three months (3 studies), five months (1 study), six months (1 study), nine months (2 studies) and twelve months (1 study).

Two studies (Hamlat et al., 2015 & Stange, Hamilton, Abramson & Alloy, 2014) that used the ALEQ also asked adolescents to complete The Life Events Interview (LEI; Safford, Alloy, Abramson, & Crossfield, 2007) with trained interviewers to check that events indicated on the ALEQ met a priori definitional criteria and occurred within the time frame indicated by the study. In one of these studies (Stange et al., 2014) mothers and adolescents both filled out separate versions of the ALEQ. The LEI has demonstrated adequate reliability and validity (Safford et al., 2007).

One study used The Life Events Scale for Children (LESC; Coddington, 1972), participants were asked to indicate which events from the LESC had occurred over past six months. The LESC includes 25 items representing stressful life events. It is a widely used measure and is related to relevant variables including physical health and psychological adjustment (Johnson, 1986). The Life Events Questionnaire (LEQ; Newcomb, Huba, & Bentler, 1981) was used as a measure of life events in one study. The LEQ has 39 items assessing positive and negative events, it has been found to correlate with measures of stress and health. This study created a negative events score, by summing the negative events that occurred during the previous six weeks.

Two studies investigated smaller scale, more frequent events or daily 'hassles'. Both studies used a hassles scale for children developed by Kanner, Feldman, Weinberger and Ford (1987). This scale contains 25 daily hassles and is a reliable and valid measure of negative hassles (Kanner et al., 1987).

Three studies assessed levels of both daily hassles and life events. Two studies used The Adolescent Perceived Events Scale (APES; Compas, Davis, Forsythe, & Wagner, 1987), but the rating period varied from one week to six months in these two studies. The APES has demonstrated adequate test-retest reliability and concurrent validity. One study (Abela et al., 2009) combined 22 life events from the Coddington Life Events Scale (Coddington, 1972, described above) with 37 hassles from the Hassles Scale for Children (Kanner et al, 1987,

described above) to create a measure of both hassles and negative life events. They asked participants whether these events had occurred in the past six weeks.

Three of the studies separated stressful events into interpersonal and non-interpersonal events (Bastin, Mezulis, Ahles, Raes, & Bijttebier, 2015; Stange et al., 2014; Cox, Funasaki, Smith & Mezulis, 2012). Three studies distinguished between dependent and independent stressors (Cox, Funasaki, Smith & Mezulis, 2012; Bijttebier, Raes, Vasey, & Feldman, 2012; Calvete, Orue & Hankin, 2015; Stange et al., 2014). Dependent events being those which at least partly depend on the adolescent's characteristics or behaviour (Stange et al., 2014).

3.2.5 Measurement of Rumination

Eight of the studies measured rumination using the rumination subscale of the Children's Response Styles Questionnaire (CRSQ; Abela, Brozina & Haigh, 2002). The CRSQ is a self-report questionnaire used to assess children's responses to depressive symptoms. The rumination subscale of the CRSQ contains 13 items representing ruminative responses to sadness. The respondent rates how often they use each response using a scale from 0 (almost never) to 3 (almost always). Reliability and validity has been established for the CRSQ-rumination subscale (Abela et al, 2002). It also demonstrates good test-retest reliability and stability over time (Hankin, 2008b).

Three studies used the brooding subscale of rumination subscale from the extended version of The Children's Response Styles Questionnaire, (CRSQ-Ext; Verstraeten et al. 2010). The brooding subscale consists of five items and demonstrates adequate internal consistency. Other measures of rumination, or subscales of rumination (e.g. brooding), included The Response Styles Questionnaire (one study; RSQ; Nolen-Hoeksema & Morrow, 1991); the Responses to Stress Scale (one study; RSS; Connor-Smith, Compas, Wadsworth, Thomsen, & Saltzman, 2000), which demonstrates good reliability and validity; the Spanish Version (Padilla & Cavete, 2011) of The Children's Response Styles Scale (2 studies; CRSS; Ziegert and Kistner 2002), which has demonstrated good convergent and divergent validity, and internal and test-retest reliabilities. One study assessed rumination as measured by the Cognitive Emotion Regulation Questionnaire, (CERQ; Garnefski & Kraaij, 2007; Portuguese version, Serra, 2009), as well as the reflection and brooding subscales of the Rumination Responses Scale-10 (RRS-10, Treynor et al., 2003; Portuguese version, Dinis, Pinto-Gouveia, Duarte, & Castro, 2011).

3.2.6 Data Analysis

Fourteen of the included studies adopted analyses that examined rumination as a moderator of the association between stressors and depressive symptoms. These studies used regression analyses to test a moderation model by testing whether rumination statistically significantly

interacts with stressors to predict depression. Seven of these studies used multi-wave design, where depressive symptoms and stressors were measured repeatedly within-person during follow-up periods, with at least two follow-up assessments. These studies (Abela & Hankin, 2011; Abela et al., 2012; Bastin et al., 2015; Cohen, Young, Gibb, Hankin, & Abela, 2014; Cox et al., 2012; Paredes & Zumalade, 2015; Skitch & Abela, 2008) all used Multi-level Modelling (MLM) to examine how the strength of the association between follow-up depressive symptoms and follow-up stressors *within* participants varied *across* participants as a function of rumination. In MLM the levels of symptoms and stressors are idiographic, because they represent within person fluctuations in depressive symptoms and stressors compared to that person's average level, rather than a group average (nomothetic).

Additionally, one of these studies using MLM (Abela & Hankin, 2011) used time-lagged analysis to test whether rumination moderates the association between negative events at Time n-1 and depressive symptoms at Time n. Time lagged analyses allows for a powerful test of the direction of effects (Abela & Hankin, 2011).

One study (Hankin, 2009) also used MLM, but in this case only depressive symptoms were measured repeatedly. As such, it was examined whether fluctuations in depressive symptoms within-subjects over time varied between subjects as a function of stressors, rumination and the rumination x stressors interaction.

The remaining six studies that explored rumination as a moderator (Abela et al., 2009; Bijttebier et al, 2012; Driscoll, Lopez & Kistner, 2009; Hamlat et al., 2015, Schwartz & Koenig, 1996; Strange et al., 2015) used a two time-point prospective design with hierarchical multiple regression analyses. For these analyses, the dependent variable was depressive symptoms and the predictors were stressors, rumination and stressors x rumination interaction (with varying covariates). In this design a nomothetic approach to analysis was taken, where the level of stressors is related to the group average, rather than the person's own average level of stressors (as described above in the idiographic approach).

Three studies examined rumination as a mediator of the association between stressors and depressive symptoms. Two studies collected data across three time-points and used structural equation modelling to test a mediational model (Calvete et al, 2015; Michl et al. 2013) to examine whether the relationship between stressors at Time 1 and depressive symptoms at Time 3 is mediated by rumination at Time 2. Anarson et al. (2016) used two-time points only and stepwise regression analysis to examine Time 1 predictors of Time 2 depressive symptoms.

All of the studies accounted for individual differences in baseline or previous levels of depressive symptoms in the analyses by including covariates in models.

3.3 Methodological quality of included studies

The quality of the studies included in this review were rated as 'fair' (12) and 'good' (5). All the studies had research questions or objectives clearly stated (criterion one). Figure 4 displays an overview of the numbers of included studies meeting each criterion of the quality assessment tool. Ratings for each paper are displayed in Appendix 5.

3.3.1 Methodological Quality of the studies that examine whether rumination moderates the relationship between stressful events and prospective depressive symptoms

Of the fourteen studies that examined whether rumination moderates the relationship between stressful events and prospective depressive symptoms, ten were rated as "fair" and four as "good" quality. All fourteen studies clearly stated their research questions or objectives. Eleven studies had clearly specified and defined study populations, three studies did not clearly define the study population. For two studies, the participation rate of eligible persons was at least 50%. If the participation rate is below 50% there is concern that the sample recruited does not represent the target population, which can limit the generalizability of the results. Eight studies did not report the participation rate. Three studies did not report the participation rate or had participation rates lower than 50%, but the sample demographic distribution was found to be representative of the target population.

Thirteen studies partially met the criterion regarding subjects being recruited from similar populations (including the same time period) and inclusion criteria being prescribed and applied uniformly to all participants. Two did not report enough information to be able to determine if they met the criterion. All 14 of the studies examining rumination as a moderator of the stress-depressive symptoms relationship included variance or effect sizes. Two studies specifically included points in their discussions that stated large sample sizes had enabled sufficient power to be obtained. Two studies stated that their large sample sizes were a strength of the study. The remaining studies did not report sample size justifications or power descriptions.

In order to make inferences about the direction of effects, the predictor variables should be measured prior to the outcome variables. All of the studies measured rumination prior to depressive symptoms. For the 14 studies examining rumination as a moderator, 12 studies measured stress prior to depressive symptoms. Although, in 11 of these studies, the self-report measures of stressors and depressive symptoms were completed at the same time-point, the participants were asked to report on stressors that occurred in the period prior to the measurement of the depressive symptoms. One study used a time-lagged approach to analyses which meant that, stressors were measured at a time point before depressive symptoms. For the two remaining studies the period of measurement of depressive symptoms and stressors referred to the same time period (the preceding week) and it therefore cannot be said that the stressors necessarily occurred prior to the depressive symptoms,

hence conclusions should not be drawn about causality. Twelve of the 14 studies examining the interaction of rumination and stressors had a follow-up time period that was sufficient to reasonably see an effect of stressors on depressive symptoms. For two of the studies the follow-up time-frame may have been too short (one week) to be able to differentiate whether the measure of depressive-symptoms was measuring symptoms or negative affect following the occurrence of a stressor.

Thirteen of the 14 studies that examined rumination as a moderator of the stressor-depressive symptom relationship used measures of the independent variables that were clearly defined, valid, reliable and implemented consistently across all study participants. One study (Schwartz & Koenig, 1996) only used a measure of stressful life events that did not have established reliability reported in the study or the study describing the original development of the measure.

All but one of the studies examining the interaction of stressful-events and rumination in the prediction of depressive symptoms (moderation) used self-report measures of stressful events, although two studies, in addition to self-report checklists, also used an interview method with trained interviewers to check that the events indicated by the participant on the self-report checklist, met a priori criteria and occurred within the time frame of interest (Hamlat et al., 2015 and Stange et al., 2015). Stange et al. (2014) also used maternal reports of life events. All of the studies included continuous measures of independent variables and 11 of the 14 studies examining rumination as a moderator measured stressful events more than once over time and only one study measured rumination more than once over time. All of the studies assessing whether rumination moderates the association between stress and depression used outcome measures that were clearly defined, valid, reliable and implemented consistently across all study participants. All but one of the studies used self-report measures of depressive symptoms. One study also used a measure of clinician-rated depressive symptoms.

Twelve of the 14 studies that examined rumination as a moderator had acceptable attrition rates of less than 20%. One study did not report the completion rate at follow-up and one study had greater than 20% drop out at follow-up, but those that completed all time-points did not differ on any of the Time 1 variables from those who dropped out. All fourteen of the studies controlled for baseline or previous time-point levels of depressive symptoms and 11 studies also measured and adjusted statistically for the potential impact of age and gender.

3.3.2 Methodological Quality of the studies that examine whether rumination mediates the relationship between stressful events and prospective depressive symptoms

Of the three studies that tested whether rumination mediates the association between stressful events and prospective depressive symptoms two were rated as “fair” and one as “good” quality. All three studies had clearly defined research questions or objectives and had clearly

specified the study population. Two of the studies had participation rates of above 50% and one study did not report the participation rate.

All three studies that examined rumination as a mediator recruited subjects from similar populations including the same time period, one of these did not report inclusion/exclusion criteria. All three studies examining rumination as a mediator reported variance or effect sizes. None of the studies explicitly reported a sample size justification but one study (Arnarson et al., 2016) suggested in its discussion that the results should be interpreted with care due to the small sample size and another study (Calvete et al., 2015) suggested that their large sample size was a strength of the study.

In the case of tests of mediation, using three time-points to test whether an exposure/predictor predicts changes in a mediator, which in turn predicts changes in the outcome provides a rigorous test of mediation (Hayes and Rockwood, 2017). Two of the three studies examining mediation used three time-points and examined all variables (stressors, rumination and depressive symptoms) at all three time-points. The remaining study examining rumination as a mediator used only two time-points, which is an acceptable but less strong test of mediation. All three studies had a follow-up time period that was sufficient to reasonably see an effect of predictors on the outcome.

Two studies that explored rumination as a mediator used measures of rumination and stressors that were clearly defined, valid, reliable and implemented consistently across all study participants. One study (Michl et al., 2013) used a measure of stressful life events that did not have established reliability reported in the study, or the study describing the original development of the measure. All three of the studies included continuous measures of independent variables and measured stressful events and rumination more than once over time. The three studies examining rumination as a mediator all used outcome measures that were clearly defined, valid, reliable and implemented consistently across all study participants.

One study had an acceptable attrition rate of less than 20%, one did not report the completion rate at follow-up and one had greater than 20% drop outs at follow-up, but those that completed all time-points did not differ on any of the Time 1 variables from those who dropped out. All three of the studies controlled for baseline or previous time-point levels of depressive symptoms.

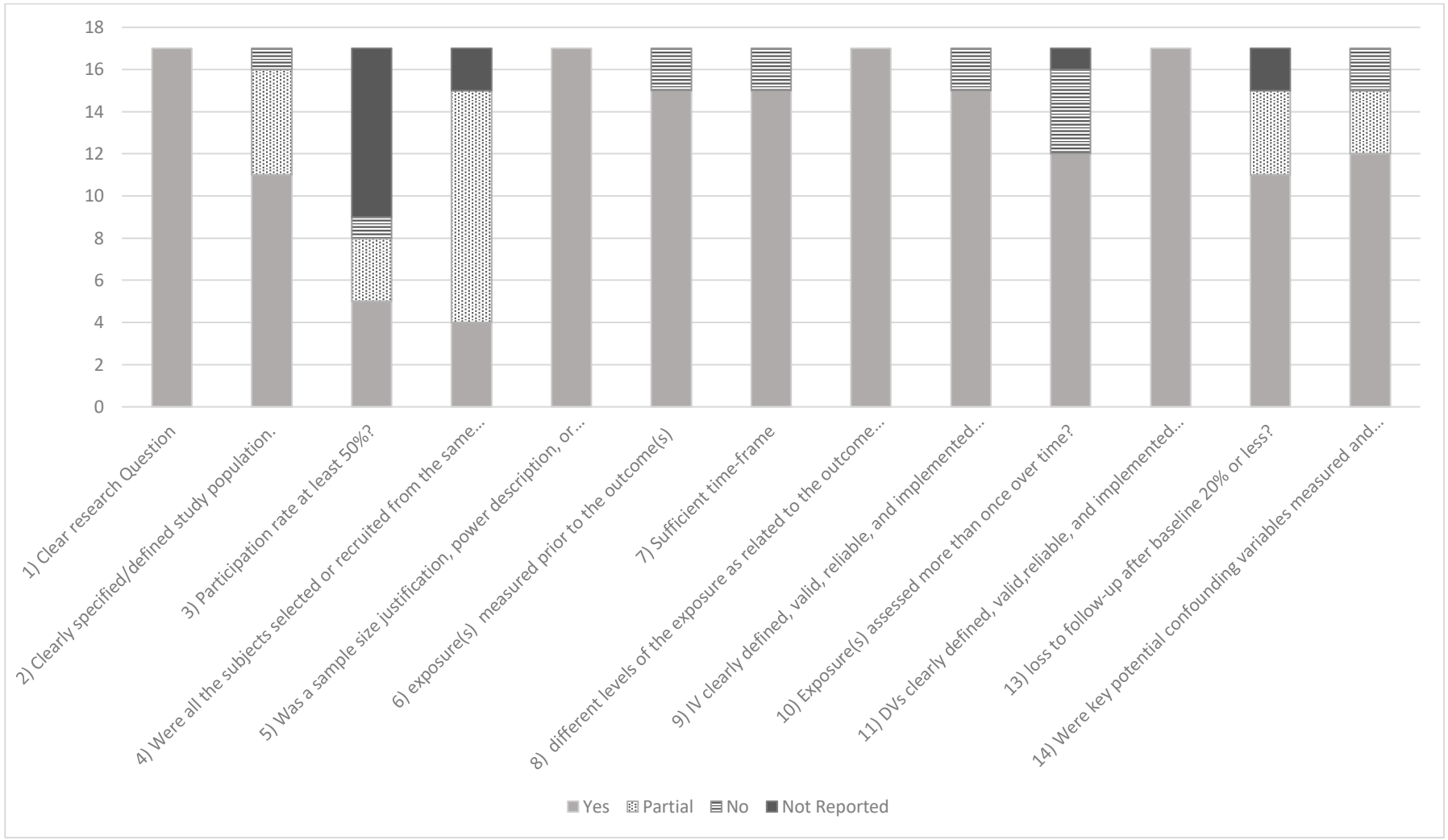

Figure 4: Proportions of the 17 included studies in the review meeting each criterion of the NIH Quality Assessment Tool.

3.4 Findings from included studies.

3.4.1 Does Rumination moderate the association between stressors and depressive symptoms?

Fourteen studies were identified that tested whether rumination moderates the relationship between stressors and prospective depressive symptoms. The reporting of findings from these fourteen studies has been grouped according to whether life events or daily hassles were measured, whether rumination or components of rumination were measured and whether stressors were separated into different types/domain of stress.

Three studies provided support for rumination moderating the relationship between life-events and prospective depressive symptoms (Abela & Hankin, 2011; Hankin, 2009; Skitch & Abela, 2008). These three studies found that rumination interacted with life events to significantly predict depressive symptoms, such that adolescents with higher levels of rumination reporting higher levels of negative life events experienced greater increases in depressive symptoms. Abela et al. (2012) found that rumination interacted with hassles to significantly predict increased depressive symptoms, providing support for rumination moderating the relationship between daily hassles and depressive symptoms.

Stange et al. (2015) separated stressors into interpersonal versus non-interpersonal events. Interpersonal stressful events being those that involve relationships with others e.g. an argument with a friend, compared to non-interpersonal events e.g. getting a bad grade (Hankin et al., 2010). They then further categorized them into dependent and independent events. Dependent events being those that at least partially depend on a person's own behaviour or characteristics, e.g. failing a test, and independent events being those that occur outside the individual's control, e.g. death of a family member (Hankin et al., 2010). They found that rumination interacted significantly with dependent-interpersonal events but not dependent-achievement events or independent-interpersonal events to predict depressive symptoms over time.

Bastin et al. (2015) examined the brooding subscale of rumination and also divided stress into interpersonal and non-interpersonal events. They found that brooding significantly moderated the effect of interpersonal stress but not non-interpersonal stress on depressive symptoms. The association between interpersonal life events and depressive symptoms was greater for those with high levels of brooding than for those with low levels of brooding. Cox et al., 2012 also assessed brooding and refection and separated stressors (negative life

events and hassles) into interpersonal versus non-interpersonal events as well as dependent and independent events. Cox et al. (2012) found that increased brooding exacerbates the effects of stressors on depressive symptoms, for total stressors, independent stressors, dependent stressors and non-interpersonal stressors, but not interpersonal stressors. Reflection did not significantly moderate the effects of stress on depression for any stress domain in Cox et al. (2012).

Driscoll et al. (2009) used a ratio response-style score (rumination/distraction), with higher scores indicating a greater tendency to ruminate versus distract in response to sadness. They also used a measure of hassles to assess stress and found that the ratio-response style score interacted with hassles to significantly predict changes in levels of depressive symptoms. Higher ratio scores were associated with greater increases in depressive symptoms for children reporting higher levels of hassles.

Three studies (Cohen et al., 2014, Hamlat et al., 2015; Schwartz & Koenig, 1996) found no support for rumination as a moderator of the association between life events and prospective depressive symptoms. Similarly, Abela et al., (2009) using a measure of stress that captured hassles as well as life events also found that rumination did not significantly interact with stressors to predict changes in levels of depressive symptoms. Furthermore, two studies found no support for either of the two subscales of rumination, brooding and reflection, interacting with life events (Peredes & Zumalade, 2015) or dependent life events (Bijttebier et al., 2012) to predict increases in depressive symptoms.

In Summary, the research quality relating whether rumination moderates the relationship between stressors and prospective depressive symptoms in adolescents was generally fair. Findings are mixed, but there is support for the role of rumination as a moderator, especially for studies rated as 'good' quality and where a multi-wave design and idiographic approach to analyses were utilised.

3.4.2 Does Rumination mediate the association between stressors and depressive symptoms?

Three studies were identified by the search strategy that examined rumination as a mediator of the longitudinal relationship between stress and depressive symptoms. Calvete et al. (2015) found the association between stressors (life events and hassles as measured by the APES) at Time 1 and depressive symptoms at Time 3 was significantly mediated by rumination. However, Michl et al., (2016) found no significant indirect effect of life events on depressive symptoms, via rumination.

Anarson et al., (2016) found baseline stressful life events did not significantly predict follow-up depressive symptoms and so further mediation analyses of the stress-depression relationship was not conducted.

The research quality relating whether rumination mediates the relationship between stressors and prospective depressive symptoms in adolescents was generally fair. However, there was a lack of evidence to support a mediation model of rumination.

4. Discussion

The aim of this systematic review was to examine the peer-review published evidence that has examined whether rumination moderates or mediates the longitudinal relationship between stressful events and depressive symptoms in adolescent populations.

4.1 Rumination as a moderator.

Fourteen longitudinal studies were identified by this review that explored rumination as a moderator of the relationship between stressors and depressive symptoms in adolescents by testing whether rumination interacted with stressors to statistically significantly predict prospective depressive symptoms. Eight of these studies found support for rumination as a moderator of the stressor-depressive symptom relationship. Four of these studies were rated as "good" quality, four were rated as "fair". Six studies found a lack of support for rumination as a moderator, with no statistically significant interaction between rumination and stressors in the prediction of prospective depressive symptoms. All six studies were rated as "fair" quality.

There did not appear to be differences between the studies that found support for rumination as a moderator and those that did not in terms of the characteristics of the studies. For instance, studies that found support for rumination as a moderator of the relationship between stressors and depression included studies with participants across the age range of adolescents and a range of follow-up periods (ranging from two months to two years). Similarly, the six studies that didn't find support for rumination as a moderator also included studies with participants across the age range of adolescents and with varying follow-up periods (ranging from 6 weeks to 18 months). There were no differences in the measures of rumination, depressive symptoms or life events used by the studies that did find support for rumination as a moderator and those that did not. The majority of studies used the CDI (Kovacs, 1985) to measure depressive symptoms and the ALEQ (Hankin & Abramson, 2002) to measure stressors and a range of measures of rumination were used.

The majority of the studies (five out of eight) that found support for rumination as a moderator of the longitudinal stressor-depressive symptom relationship used a multi-wave design with multi-level modelling as the analytic approach. This approach to analysis has the benefit of modelling stressors and depressive symptoms idieographically (i.e. within-person) so that levels of symptoms and stressors are compared to the average level of that person and trajectories of symptoms and stressors are plotted over time, within-person, representing each individual's stress-reactivity. Rumination is then examined as a moderator by testing whether the strength of the association between follow-up depressive symptoms and follow-up stressors *within* participants varied *across* participants as a function of rumination (Abela & Hankin, 2011). This is in contrast to the studies that had just two time-points and used a nomothetic approach to analysis where each individual's mean level of depressive symptoms and stressors are compared to the group's mean level of stressors. The multi-wave, idiographic approach enables a relatively reliable estimate of the degree of stress-reactivity for each participant and it has been demonstrated to be the optimal approach for testing vulnerability-stress models (Bastin et al., 2015, Abela & Hankin, 2011). In contrast, the studies that found a lack of support for rumination as a moderator of the stressor-prospective depressive symptom relationship predominantly (4 out of 6 studies) used a two-point design and a nomothetic approach to analysis.

With regards to the quality of the studies that examined rumination as a moderator of the stress-depressive symptoms relationship, the key strengths identified in the quality assessment were related to the design of the studies. The majority of studies measured predictors (rumination and stressors) prior to outcome (depressive symptoms), which allows a more reliable estimation of direction of effects than if predictors and outcome are measured concurrently. The majority of studies also measured stressors more than once over time, which allows a more reliable estimate of the level of stress experienced compared to when stress is only measured at one time-point. All but two of the studies also used a reasonable follow-up time period that was sufficient to reasonably see an effect of stressors and rumination on depressive symptoms. Other strengths included acceptable attrition rates, the use of valid and reliable measures or predictors and outcome variables and good consideration and adjustment for key potential confounding variables.

The main weakness of the studies that examined rumination as a moderator of the longitudinal relationship between stressors and depressive symptoms was the participation rate, with many studies not reporting enough information for the participation rate to be determined and only two studies reporting that they had a participation rate of at least 50%.

If the participation rate is below 50% there is a concern that the sample obtained may not represent target population, which might limit generalizability of results.

Three of the studies examined whether the moderating effect of rumination varied depending on the type of stressor. Bastin et al. (2015) found that rumination significantly moderated the effect of interpersonal stress but not non-interpersonal stress on depressive symptoms. Similarly, Stange et al. (2015), found that rumination interacted significantly with dependent-interpersonal events but not dependent-achievement life events or independent-interpersonal life events to predict depressive symptoms over time. These results indicate rumination may be more likely to lead to depression following dependent interpersonal stressors than following independent-interpersonal or non-interpersonal stressors. Although this finding was not supported by Cox et al. (2012), who found that rumination moderated the effects of total stressors, independent stressors, dependent stressors and non-interpersonal stressors, but not interpersonal stressors. These results warrant further investigation into whether rumination might exacerbate certain subtypes of stressful events but not others.

4.2 Rumination as a mediator.

Only three studies were identified that examined rumination as a mediator of the relationship between stress and depression. One study (Calvete et al. 2015), rated as 'fair' quality found support for rumination as a mediator and one (Michl et al., 2016), rated as 'good' quality, did not. In the third study (Arnarson et al., 2016), rated as 'fair' quality, baseline stressful life events did not significantly predict follow-up depressive symptoms and so further mediation analyses of the stress-depression relationship were not conducted.

Of the two studies that did conduct mediation analyses, both examined a similar age range but differed in their use of measures of stressors and rumination. The study that found support for rumination mediating the longitudinal relationship between stressors and depressive symptoms (Calvete et al., 2015) used the CRSS (Ziegert and Kistner 2002) as a measure of rumination and the APES as the stressor measure. The APES measures levels of both daily hassles and life events. Calvete et al., (2015) also specifically measured only dependent events. The study that did not find support for rumination mediating the longitudinal association between stressors and depressive symptoms used the LESC (Coddington, 1972), a measure of major life events and the rumination scale of the CRSQ (Abela et al, 2002).

Both Calvete et al. (2015) and Michl et al. (2016) used an optimal design for testing mediation by using three time-points to test whether an exposure/predictor predicts changes in a mediator which in turn predicts changes in the outcome (Hayes & Rockwood, 2017). Further studies, utilising designs that allow for strong tests of mediation (Hayes & Rockwood, 2017) are required to clarify the role of rumination as a mediator of the association between stressors and prospective depressive symptoms.

With regard to the quality of the studies examining rumination as a mediator of the relationship between stressors and prospective depressive symptoms, the key strengths of the studies, as assessed by the quality assessment tool, were that predictors were measured more than once over time, that two of the three studies had participation rates of above 50% and that follow-up time periods were sufficient to reasonably see an effect of predictors on the outcome. All but one of the measures used across predictors and outcomes were valid and reliable. One study (Michl et al., 2013) used a measure of stressful life events that did not have established reliability reported in the study, or the study describing the original development of the measure. The key weakness of the studies was the retention of participants at follow-up, with just one of the three studies reporting an acceptable attrition rate.

4.3 Other findings

One notable finding from the review concerns the reliance throughout the studies on self-report measures of stressors and depressive symptoms. Fifteen out of the 17 studies included in the review used retrospective self-report checklists of stressful events or hassles. Sixteen of the included studies relied solely on self-report measures of depressive symptoms and 14 relied solely on self-report measures of stressful events. This is problematic because symptoms present at the time of reporting of retrospective life events may have a confounding effect on stressors due to mood-congruent memory bias (Watkins, Vache, Verney, & Mathews, 1996). The recall of retrospective events could have been biased by mood at the time of reporting, such that those with higher depressive symptoms may have recalled an increased number of events, thereby conflating the association between stressors and depression. Using additional informants for life events measures such as teachers or parents, or contextual-threat interview methods, where events are coded by independent raters according to their stressfulness (Grant, Compas, Thurm, McMahon & Gipson, 2004), may go some way to improving the objectivity of stressor measurement. One of the studies (Stange et al., 2014) did use maternal reports of stressful events as well as self-reports and found support for rumination moderating the effect of stressors on depressive symptoms. Two of

the studies reviewed in the current paper included interview methods where trained interviewers checked that events reported on the ALEQ met a priori criteria and occurred during the time period of study. Although these interview methods may have improved the objectivity of retrospective event reporting, these were not *contextual threat* interviews since they did not include codings of the stressfulness of the events.

Another important finding relates to the measures used to capture stressors. Although the majority of the studies used valid and reliable measures of negative life events (15 out of 17 studies). There was a variety of life events measures used and even where studies used the same measure (e.g. the ALEQ), how this measure was used varied considerably from study to study. For instance, studies utilising the ALEQ differed regarding the number of items, the time period over which respondents were asked to retrospectively recall events and the response format. The lack of consistency of stressor measurement across the studies makes comparison of results difficult and it is recommended that future research attempts to address this inconsistency.

4.4 Review strengths and limitations

The main strengths of the current review are the use of a systematic, thorough and replicable search strategy and that the quality assessment tool was selected specifically because it was designed for use with observational studies, the items of which suited the aim of the current review. The fact that 5 out of the 17 studies were independently rated for quality by a second researcher helped to minimise researcher bias.

There are a number of limitations that should be noted. Firstly, all the studies found by the review included community samples of adolescents and it therefore cannot be determined whether the findings would generalise to clinical samples, to explore whether rumination interacts with stressors to exacerbate depressive symptoms in already depressed adolescents.

The current study focused only on studies that used depressive symptoms as an outcome and therefore did not address the specificity of the stress-rumination interaction to symptoms of depression. Furthermore, given that the focus was on depressive symptoms rather than depressive episodes, it should not be assumed that the findings in the included studies would extend to predicting depressive episodes. Although Abela & Hankin (2011) did find that the rumination-stressor interaction significantly predicted future depressive episodes as well as changes in symptoms. Future research could include clinical interview

methods to see if Abela and Hankin's finding relating to the development of depressive symptoms can be replicated.

4.5 Conclusions

Findings of the current review provide tentative support for the cognitive vulnerability-stress model of rumination in the prediction of depressive symptoms in adolescents. Eight of out of fourteen studies found support for rumination as a moderator of the stressor-depressive symptoms and the finding that all of the studies rated as 'good' found significant rumination x stressor interactions adds further support for rumination as a moderator of the stressor-depressive symptoms relationship in adolescence. However, six of the studies did not find statistically significant rumination x stressor interactions and therefore the overall support for rumination as a moderator of the longitudinal stressor-depressive symptoms relationship within adolescents is mixed.

Only three studies were identified that examined rumination as a mediator of the longitudinal relationship between stressors and depressive symptoms. Further research is required to evaluate whether rumination might be one mechanism via which stressors contribute to prospective depressive symptoms.

The findings in this review provide mixed support for conceptualising rumination within a vulnerability-stress framework (moderation model of rumination) and little support for mediation models (control theories) of rumination. In terms of clinical implications regarding the role of rumination as a response to stressful events in the development of depression in adolescents, the findings of the current review suggest that there is not strong evidence to recommend that clinicians should focus on formulating rumination as a response to negative-events (stress-vulnerability model). However, a meta-analysis by Rood et al. (2009) provides support for rumination as a main-effect predictor of depressive symptoms, suggesting rumination should be a target for intervention as a general vulnerability factor for depressive symptoms in adolescents.

Future research examining rumination as a moderator of the relationship between stressors and prospective depressive symptoms should utilise a multi-wave assessment of stressors and depressive symptoms, allowing an idiographic approach to analysis, should improve reporting of participation rates and use other informants or interview methods to improve objectivity of stressor measurement and measure clinical depressive episodes as opposed to just symptoms. Future research should also improve consistency in the measurement of stressful events in order to allow better comparison across studies.

Findings from three studies suggest that rumination may be more likely to lead to depression following certain types of stressor than others. Further studies investigating rumination in the context of different domains of stressor is warranted to explore this further.

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Appendix 1: Search terms and results for Embase.

1	ruminat*.mp.	4899	Advanced
2	response style*.mp.	732	Advanced
3	brooding.mp.	973	Advanced
4	repetit* thought.mp.	74	Advanced
5	repetit* think*.mp.	72	Advanced
6	1 or 2 or 3 or 4 or 5	6244	Advanced
7	life stress/ or stress/	128417	Advanced
8	stress*.mp.	1114400	Advanced
9	life event/	26356	Advanced
10	negative life event*.mp.	1877	Advanced
11	hassle*.mp.	2821	Advanced
12	daily hassle*.mp.	628	Advanced
13	life event*.mp.	32523	Advanced
14	negative event*.mp.	1767	Advanced
15	exp depression/ or mood disorder/	418313	Advanced
16	depress*.mp.	674848	Advanced
17	dysphori*.mp.	9985	Advanced
18	depress* symptom*.mp.	59160	Advanced
19	15 or 16 or 17 or 18	721904	Advanced
20	7 or 8 or 9 or 10 or 11 or 12 or 13 or 14	1135431	Advanced
21	adolescence/ or adolescent/	1464086	Advanced
22	adolescen*.mp.	1536297	Advanced
23	child*.mp.	2474504	Advanced
24	youth.mp.	62682	Advanced
25	young.mp.	711895	Advanced
26	early adolescen*.mp.	6146	Advanced
27	mid* adolescen*.mp.	1285	Advanced
28	late* adolescen*.mp.	4617	Advanced
29	21 or 22 or 23 or 24 or 25 or 26 or 27 or 28	3617262	Advanced
30	6 and 19 and 20 and 29	237	Advanced

Appendix 2: Search terms and results for Medline.

1	ruminat*.mp.	3465	Advanced
2	response style*.mp.	552	Advanced
3	brooding.mp.	847	Advanced
4	repetit* thought.mp. [mp=title, abstract, original title, name of substance word, subject heading word, keyword heading word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	33	Advanced
5	repetit* think*.mp.	37	Advanced
6	Stress, Psychological/	115373	Advanced
7	stress*.mp.	816705	Advanced
8	negative life event*.mp.	1533	Advanced
9	hassle*.mp.	1370	Advanced
10	daily hassle*.mp.	514	Advanced
11	life event*.mp.	12236	Advanced
12	negative event*.mp.	1335	Advanced
13	Depression/	109013	Advanced
14	depress*.mp.	475326	Advanced
15	dysphori*.mp.	4768	Advanced
16	mood disorders/ or exp depressive disorder/	118976	Advanced
17	depress* symptom*.mp.	42850	Advanced
18	adolescent/ or child/	2794998	Advanced
19	adolescen*.mp.	2046589	Advanced
20	child*.mp.	2272757	Advanced
21	youth.mp.	53860	Advanced
22	young.mp.	1065746	Advanced
23	early adolescen*.mp.	5106	Advanced
24	mid* adolescen*.mp.	1133	Advanced
25	late* adolescen*.mp.	3626	Advanced
26	1 or 2 or 3 or 4 or 5	4629	Advanced
27	6 or 7 or 8 or 9 or 10 or 11 or 12	823024	Advanced
28	13 or 14 or 15 or 16 or 17	486719	Advanced
29	18 or 19 or 20 or 21 or 22 or 23 or 24 or 25	3832328	Advanced
30	26 and 27 and 28 and 29	267	Advanced

Appendix 3: Search terms and results for Psychinfo.

1	"rumination (cognitive process)"/	1760	Advanced
2	ruminat*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]	5647	Advanced
3	response style*.mp.	2195	Advanced
4	brooding.mp.	725	Advanced
5	repetit* thought.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]	104	Advanced
6	repetit* think*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]	109	Advanced
7	stress/ or academic stress/ or environmental stress/ or psychological stress/ or social stress/	65042	Advanced
8	stress*.mp.	256164	Advanced
9	life experiences/ or "experiences (events)"/	40321	Advanced
10	negative life event*.mp.	2561	Advanced
11	daily hassle*.mp.	1267	Advanced
12	hassle*.mp.	2367	Advanced
13	life event*.mp.	20656	Advanced
14	negative event*.mp.	2513	Advanced
15	affective disorders/ or major depression/	119831	Advanced
16	depress*.mp.	315712	Advanced
17	"depression (emotion)"/	24111	Advanced
18	dysphori*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]	5866	Advanced
19	depress* symptom*.mp.	46120	Advanced
20	adolescen*.mp.	244336	Advanced
21	child*.mp.	693222	Advanced
22	youth.mp.	83179	Advanced
23	young.mp.	186256	Advanced
24	early adolescen*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]	8652	Advanced
25	mid* adolescen*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures]	1713	Advanced
26	late* adolescen*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests &	5269	Advanced

27	1 or 2 or 3 or 4 or 5 or 6	7611	Advanced
28	7 or 8 or 9 or 10 or 11 or 12 or 13 or 14	297106	Advanced
29	15 or 16 or 17 or 18 or 19	324501	Advanced
30	20 or 21 or 22 or 23 or 24 or 25 or 26	925362	Advanced
31	27 and 28 and 29 and 30	298	Advanced

Appendix 4: National Institute of Health Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies

Criteria	Yes	No	Other (CD, NR, NA)*
1. Was the research question or objective in this paper clearly stated?			
2. Was the study population clearly specified and defined?			
3. Was the participation rate of eligible persons at least 50%?			
4. Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?			
5. Was a sample size justification, power description, or variance and effect estimates provided?			
6. For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured?			
7. Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed?			
8. For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)?			
9. Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?			
10. Was the exposure(s) assessed more than once over time?			
11. Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants?			
12. Were the outcome assessors blinded to the exposure status of participants?			
13. Was loss to follow-up after baseline 20% or less?			
14. Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?			

*CD = cannot determine; NA = not applicable; NR = not reported.

Appendix 5: Data Extracted from Included Studies.

Author	Year	Measure of depressive symptoms	Measure of rumination	Measure of stressor	Analysis	Results
Abela, J. R. and B. L. Hankin	2011	CDI K-SADS Severity Score (clinician rated depression symptoms)	CRSQ, only Rumination subscale used.	ALEQ, rating time-period = past 3 months.	MLM * Used contemporaneous (association between Time n ALEQ and Time n CDI) and time-lagged (association between Time n CDI and Time n-1 ALEQ) analyses. Covariates = Site, sex, age, initial depressive symptoms, past history of MD, CDI at Time n – 1.	Significant rumination x ALEQ interaction for self-rated contemporaneous (B = 0.02, SE = 0.01, F = 5.06, p<0.05, df = 1,1856), self-rated lagged (B = 0.02, SE = 0.01, F = 7.23, p<0.01, df = 1, 1744) clinician rated contemporaneous (B = 0.01, SE = 0.00, F = 6.09, p<0.05, df = 1, 982) and clinician rated lagged (B= 0.01, SE = 0.00, F = 9.03, P<0.01, df =1, 859). For all, associations between ALEQ and CDI significantly greater in adolescents with high rumination than low rumination.
Abela, J. R., et al.	2012	CDI	CRSQ, only Rumination subscale used.	HASC, rating time-period = past 5-9 days.	MLM* Controlled for T1 CDI and lagged links between adjacent CDI scores. Included age and sex in level 2.	Significant rumination x hassles interaction (*b*= 0.10, SE = 0.03, F= 11.15, p < 0.01, df = 1,204). The slope of the relationship between hassles and FU-CDI significantly

Author	Year	Measure of depressive symptoms	Measure of rumination	Measure of stressor	Analysis	Results
						greater with high levels of rumination than low levels of rumination (t(204)=3.34, p<0.01).
Abela, J. R., et al.	2009	CDI, removed suicidality item.	CRSQ, only CRSQ-Rumination subscale used (13 items).	The Children's Life Events Scale: 37 items come from the HASC, 22 items come from CLSS. Rating time-period = past 6 weeks.	Hierarchical Linear Regressions**	The CRSQ x life event interaction was not a significant predictor of residual change in CDI scores (pr =0.03), t(314) = 0.44, ns.
Arnarson, E. O., et al.	2016	CDI, Portuguese version (Marujo, 1994).	CERQ Portuguese version (Serra 2009). Rumination Responses Scale-10 (RRS-10; Treynor et al. 2003; Portuguese version: Dinis et al. 2011). Used reflection & brooding component scores.	ALEQ, Portuguese version (Fernandes 2011b). Rating time-period = past 12 months.	Stepwise regression analysis to check which 11 variables at T1 had a predictive effect on T2 CDI. Mediation analyses, using Bootstrapping with 95% confidence interval (CI) utilized to determine significance of mediation effects. Controlled for T1 depressive symptoms.	ALEQ not a significant predictor of T2 CDI so was not included in further mediation analyses.
Bastin, M., et al.	2015	CDI	CRSQ-Ext. Used brooding subscale = 5	Subset of 40 items from ALEQ, categorized into	MLM*	Brooding significantly moderated the effect of interpersonal stress

Author	Year	Measure of depressive symptoms	Measure of rumination	Measure of stressor	Analysis	Results
			items brooding Scores range from 5 to 20.	interpersonal versus non-interpersonal stressors. Rating time-period = past 3 months.	Sex included in analyses as a control variable.	(estimate = 0.13, SE = 0.05, *t* = 2.46, p < 0.05) but not non-interpersonal stress (estimate = −0.03, SE = 0.13, *t*= −0.19, ns) on depressive symptoms. Association between interpersonal events and depressive symptoms significantly stronger for participants with high brooding (coefficient=0.54, t=8.56, p<0.001) compared to low brooding (coefficient=0.36, t=5.21, p<0.001).
Bijttebier, P., et al.	2012	CDI	Used Brooding & Reflection subscales from Rumination subscale of CRSQ-Ext.	Subset of 22 dependent stressful events from ALEQ. Rating time-period = past 3 months.	Hierarchical Linear Regressions** Sex and age included as additional control variables.	No significant brooding x stress (β = -0.11, n.s) or reflection x stress (β = 0.10 n.s) interaction.
Calvete, E., et al.	2015	CES-D; Spanish version	CRSS, Spanish version (Padilla & Calvete, 2011).	Short version of the APES, as employed by Hankin,	Structural Equation Modelling	Rumination significantly predicted increased depressive symptoms from T1 to T2 (β = 0.10, p<.05) and from T2

Author	Year	Measure of depressive symptoms	Measure of rumination	Measure of stressor	Analysis	Results
		(Calvete & Cardeñoso, 1999).		Abramson, and Siler, (2001). Rating time-period = past 6 months.	Used a cross-lagged design, which controlled for all reciprocal relationships among variables over the 3 waves.	to T3 (β = 0.14, p< 0.001)). Stressors at T2 predicted an increase of depressive symptoms at T3 (β = 0.13, p<0.001) but not for T1 stressors to T2 depressive symptoms (no statistics reported). The link between T1 stressors and T3 depressive symptoms was mediated by rumination (indirect effect 95% CI: 0.02–0.03).
Cohen, J. R., et al.	2014	CDI	CRSQ, only CRSQ-Rumination subscale used.	Abbreviated form of the ALEQ. Rating time-period = past month.	MLM* CDI at Time T-1 entered as a covariate when predicting CDI at Time T. Sex and grade entered as covariates in all analyses. Also account for concurrent (anxiety) symptoms.	No support for rumination interacting with stressors to predict depressive symptoms (b = 0.009; SE = 0.005; t(2495) = 1.61, p = 0.10, $r_{effect\ size}$ = 03).

Author	Year	Measure of depressive symptoms	Measure of rumination	Measure of stressor	Analysis	Results
Cox, S., et al.	2012	CDI.	Reflection and brooding subscales of the RSQ	APES, stressors separated into independent & dependent stressors. Rating time-period = past week.	MLM* Approach accounts for previous levels of CDI.	Brooding significantly moderated the effects of stress on depressive symptoms for total stressors (coefficient = 0.07, t =2.36, p=0.02) independent stressors (coefficient =0.16, t=2.26, p=0.02); dependent stressors (coefficient =0.11, t=2.54, p =0.01); and non-interpersonal stressors (coefficient =0.31, t =4.08, p=0.00), but not interpersonal stressors (coefficient =0.07, t=1.59, p=0.11). For all analyses, association between stress and depressive symptoms was stronger for increased brooding. Reflection did not significantly moderate the effects of stress on depression for any stress domain.
Driscoll, K. A., et al.	2009	CDI	Used Rumination / Distraction ratio scores from CRSS.	CHS. Created a change score (CHS-Change).	Hierarchical linear regressions**	Significant response style x stress interaction (ΔR^2 =0.02, F_{inc} (1, 196) = 8.92; β = 0.16, $p < 0.01$). Higher ratio

Author	Year	Measure of depressive symptoms	Measure of rumination	Measure of stressor	Analysis	Results
					Sex & age included as additional control variables.	scores associated with increased risk for depressive symptoms for children with higher levels of stress.
Hamlat, E. J., et al.	2015	CDI	CRSQ, only CRSQ-Rumination subscale used.	ALEQ and LEI. Rating time-period = past 9 months.	Hierarchical linear regressions** Additional control variables: Free lunch status, age at baseline, race, time between baseline and follow-up, and childhood stressful life events experienced before baseline.	No CRSQ X negative life event interaction (β=0.01, t = 1.77 ns).
Hankin, B. L.	2009	CDI	CRSQ, only CRSQ-Rumination subscale used.	ALEQ. Rating time-period = past 5 months.	Hierarchical linear modelling.	Significant rumination x stress interaction for predicted intercepts (b= 0.009, t= 6.11) p< 0.01, ES (r) =. 32) and trajectories (b=0.1, t= 742), p<.001, ES (r) = 0.37) of CDI such that youth with a more ruminative response style who reported more stressors experienced higher elevations in CDI.

Author	Year	Measure of depressive symptoms	Measure of rumination	Measure of stressor	Analysis	Results
Michl, L. C., et al.	2013	CDI, removed suicidality item.	CRSQ, only CRSQ-Rumination subscale used.	LESC Rating time-period = past 6 months.	Structural equation modelling. Standard tests of statistical mediation were employed. Used bootstrapping to test the significance of the mediator.	T1 stressful life events was marginally associated with T3 CDI, controlling for T1 CDI, (β= 0.06, p = 0.053). T1 life events associated with Time 2 rumination, controlling for T1 rumination (β = 0.08, p=0.007; this relationship remained significant, even when internalizing symptoms at T1 were added to the model). T2 rumination associated with T3 CDI, controlling for T1 CDI and rumination, (β = 0.19, p <0.001). T1 life events were not associated significantly with T3 CDI, controlling for T1 CDI and rumination, when T2 rumination was added to the model, β = 0.03, p = 0.393. The indirect effect of life events on CDI through rumination was not statistically significant (point estimate = 0.01; 95% CI [-0.01, 0.03]).
Padilla Paredes,	2015	CES-D; Spanish	Spanish adolescent version (Padilla and	Short version of ALEQ.	MLM*	No significant interactions between brooding or reflection and stressors

Author	Year	Measure of depressive symptoms	Measure of rumination	Measure of stressor	Analysis	Results
P. and E. Calvete Zumalde		version (Calvete & Cardeñoso, 1999) – over the past month.	Calvete, 2011) of the Ruminative Responses subscale from the CRSS. Brooding and reflection subscales used.	Rating time-period = past 6 months.	DV = Time T CDI. Time T-1 CES-D scores were included in the Level 1 model along with stressors at Time T. Measures of stressors were centred within person. Included gender in the model.	(coefficient = -0.04, p=0.921 and coefficient = 0.26, p=0.455 respectively).
Schwartz, J. A. J. and L. J. Koenig	1996	BDI	RSQ. Used rumination and distraction scales only.	LEQ Rating time-period = past month – 6 weeks.	Regression analyses used to predict T3 BDI. Step 1: T1 BDI. Step 2: rumination & distraction. Step 3: Number of NLE (since T1 = 6 weeks) entered on step 3 to test for its direct effect. Step 4 = interactions between NLE and rumination (among other variables).	No significant interaction effects (beta = -0.09, n.s) of NLE x rumination.
Skitch, S. A. and J. R. Abela	2008	CES-D – rated over the past week.	RSS. Used the rumination subscale - 3 items.	ALEQ, over the past month.	MLM* Follow-up ALEQ mean centred.	Significant Rumination x FU-stress interaction (β= 0.05, SE=0.02, F=4.57, p<0.05). Follow-up analyses found the slope was significantly greater in

Author	Year	Measure of depressive symptoms	Measure of rumination	Measure of stressor	Analysis	Results
					Initial depressive symptoms included in the model. For all analyses, between-subject (Level II) predictors were standardized prior to analyses.	adolescents reporting high rumination than low rumination (t(255)= 2.15, p<0.05).
Stange, J. P., et al.	2014	CDI	CRSQ. Used a 2 factor structure (Abela et al., 2007) of rumination and distraction/problem solving.	ALEQ and LEI, self-report & mother-report. Rating time-period = past 9 months. Events subdivided into achievement and interpersonal domains, and further categorized as dependent or independent.	Hierarchical Linear Regressions**	Significant rumination x dependent-interpersonal events interaction (β = 0.13, t = 2.82, p<0.01, change in R^2 = 0.02, p<0.01). Dependent-interpersonal events predicted CES-D more strongly for higher rumination (b=0.53, t =6.93, p<.0001) than lower rumination (b=0.24, t=3.06, p<.005). Rumination did not interact with dependent-achievement events (β=0.05, t= 1.08, n.s., change in R^2 = <0.01, ns) or with independent-interpersonal events (β =0 .04, t = 0.88,ns, change in R^2 = <0.01, ns) to predict FU CES-D.

Key: ***B =*** unstandardized coefficient, **β =** standardized coefficient**, CDI** = Children's Depression Inventory (Kovacs, 1981, 2003) , **CES-D =** Centre for Epidemiological Studies Depression Scale (Radloff, 1977), **K-SADS** = (Kaufman, et al., 1996) Semi-structured clinical interview designed to arrive at Diagnostic and Statistical Manual of Mental

Disorders (4th Edition; DSM-IV) diagnostic criteria disgnoses; **CRSQ =** Children's Response Styles Questionnaire (Abela et al. 2002, 2004), **CRSQ-Ext** = Children's Response Styles Questionnaire – Extended version, Verstraeten et al. 2010); **CERQ** = Cognitive Emotion Regulation Questionnaire (Garnefski & Kraaij, 2007); **CRSS** = Children's Response Styles Scale (Ziegert and Kistner 2002), **RSS** = Responses to Stress Scale (Connor-Smith et al. 2000); **RSQ** = The Response Styles Questionnaire (Nolen-Hoeksema, 1991), **ALEQ** = Adolescent Life Events Questionnaire (Hankin & Abramson, 2002), **LEI** = Life Events Interview (Safford, Alloy, Abramson, & Crossfield, 2007) **CLSS/LESC =** The Coddington Life Stress Scale for Children / The Life Events Scale for Children (Coddington, 1972) **CHS / HASC** = Child Hassles Scale / Hassles Scale for Children (Kanner et al. 1987) **LEQ =** The Life Events Questionnaire (Newcomb, Huba, & Bentler, 1981); **APES** = Adolescent Perceived Events Scale (Compas, Davis, Forsythe, & Wagner, 1987); **MLM** = Multi-Level Modelling, **FU =** follow up, **NLE =** Negative Life Events, **MD =** Major Depressive Episode.

*MLM, multi level modelling was used to evaluate the effect of rumination (or components of rumination e.g. brooding & reflection) on the association between stressors and depressive symptoms. MLM analyses examined whether the slope of the relationship between negative events and increases in depressive symptoms *within* participants varied *across* participants as a function of rumination. MLM for these studies included the construction of level 1 and level 2 equations. The dependent variable (DV) was depressive scores over the follow-up (depressive symptoms at time T). Each equation captures an intercept (initial level of depressive symptoms) and a slope (change in depressive symptoms). Level 1 equations modelled variation in the repeatedly measured DV (depressive symptoms) as a function of time and other repeatedly measured predictor variables (in this case, stress), i.e. level 1 equations model within person variation in depressive symptoms as a function of time and stress. Level 2 equations model the individual differences in level 1 variables as a function of level 2 variables (rumination), i.e. Level 2 equations explain differences between the Level 1 trajectories as a function of rumination (and any other between-subjects predictors included in the study). Rumination is tested as a moderator of the within-person depressive symptoms -stressor association, by adding rumination as a between-subjects variable at level 2. This represents a cross-level interaction. MLM takes an idiographic approach to analyses by examining the relationship between stressors and symptoms in the follow-up period, within-person, for each adolescent, meaning that symptoms and stressors entered at Level 1 represent upward or downward fluctuations relative to participants' own mean level of stress/symptoms.

**Hierarchical linear regressions were used to evaluate whether rumination (or subscales of rumination) interact with stressors (life events and/or hassles) to prospectively predict changes in levels of depressive symptoms. Dependent variable = Time 2 depressive symptoms. Independent variables = Time 1 depressive symptoms and any other covariates entered first, followed by rumination (or subscales of rumination) and stressors, before the interaction of stressors x rumination (or subscale of rumination).

Appendix 6: Quality assessment ratings for included studies.

PAPER	1) Research Question or objective clearly stated?	2) study population clearly specified and defined?	3) Participation rate of eligible persons at least 50%?	4) subjects from similar pops? Inc. criteria applied uniformly?	5) sample size justification or effect sizes reported?	6) IVs measured prior to outcome?	7) sufficient time frame?	8) different levels of the exposure measured?	9) IVs clearly defined, valid, reliable, and implemented consistently?	10) IVs assessed more than once over time?	11) DV clearly defined, valid, reliable, and implemented consistently?	13) was loss to follow-up after baseline 20% or less?	14) key confounding variables measured and adjusted for?	Overall rating
Abela & Hankin (2011)	Yes	Partial	NR	Partial	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Partial	Yes	FAIR
Abela, et al. (2012)	Yes	Partial	NR	Partial	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	FAIR
Abela, et al. (2009)	Yes	Partial	Yes	Partial	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Partial	FAIR
Arnarson, et al. (2016)	Yes	Yes	CD/NR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NR	Yes	FAIR
Bastin, M., et al. (2015)	Yes	Partial	Yes	Partial	Yes	Yes.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	GOOD
Bijttebier, et al. (2012)	Yes	No	NR	NR	Yes	Yes	Yes	Yes	Yes	CD	Yes	Yes	Yes	FAIR
Calvete, et al. (2015)	Yes	Yes	Yes	Partial	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	FAIR
Cohen, et al. (2014)	Yes	Yes	NR/CD	NR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	FAIR

PAPER	1) Research Question or objective clearly stated?	2) study population clearly specified and defined?	3) Participation rate of eligible persons at least 50%?	4) subjects from similar pops? Inc. criteria applied uniformly ?	5) sample size justification or effect sizes reported?	6) IVs measured prior to outcome?	7) sufficient time frame?	8) different levels of the exposure measured ?	9) IVs clearly defined, valid, reliable, and implemented consistently?	10) IVs assessed more than once over time?	11) DV clearly defined, valid, reliable, and implemented consistently?	13) was loss to follow-up after baseline 20% or less?	14) key confounding variables measured and adjusted for?	Overall rating
Cox, et al. (2012)	Yes	Partial	CD/NR	Partial	Yes	No	No	Yes	Yes	Yes	Yes	Yes	No	FAIR
Driscoll, et al. (2009)	Yes	Yes	Partial	Partial	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	GOOD
Hamlat, et al. (2015)	Yes	Yes	NR	Partial	Yes	Yes	Yes	Yes	Yes	No	Yes	Partial	Yes	FAIR
Hankin, (2009)	Yes	Yes	Yes	Partial	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	GOOD
Michl, et al. (2013)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	yes	Partial	Yes	Yes	Partial	Partial	GOOD
Padilla Paredes & Zumalde (2015)	Yes	Yes	NR	partial	Yes	Yes	Yes	Yes	Yes	Yes	yes	Partial	Yes	FAIR
Schwartz & Koenig (1996)	Yes	Yes	No	yes	Yes	Yes	yes	yes	Partial	No	yes	yes	Partial	FAIR.

PAPER	1) Research Question or objective clearly stated?	2) study population clearly specified and defined?	3) Participation rate of eligible persons at least 50%?	4) subjects from similar pops? Inc. criteria applied uniformly?	5) sample size justification or effect sizes reported?	6) IVs measured prior to outcome?	7) sufficient time frame?	8) different levels of the exposure measured?	9) IVs clearly defined, valid, reliable, and implemented consistently?	10) IVs assessed more than once over time?	11) DV clearly defined, valid, reliable, and implemented consistently?	13) was loss to follow-up after baseline 20% or less?	14) key confounding variables measured and adjusted for?	Overall rating
Skitch & Abela (2008)	Yes	Yes	partial	partial	Yes	yes	Yes	Yes	Yes	yes	Yes	NR	Yes	FAIR.
Stange, et al. (2014)	Yes	Yes	partial	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	GOOD.

Main Research Project

RUMINATION AND CO-RUMINATION AS MODERATORS OF THE RELATIONSHIP BETWEEN STRESS AND DEPRESSIVE SYMPTOMS: EXAMINING DIFFERENT DOMAINS OF LIFE EVENTS AND HASSLES

Supervised by Dr Eleanor Leigh and Dr Patrick Smith

Contents

Abstract

The purpose of this prospective study was to explore rumination and co-rumination as moderators of the relationship between stressors and depressive symptoms for negative life-events as well as daily hassles and to explore whether their moderating effect differed depending on the type of stressors. A prospective, longitudinal, multi-wave design was used in a sample of 12-14-year olds, consisting of three stages of data collection over 6 months. Participants completed self-report measures of depressive-symptoms, response styles and co-rumination at baseline. 5 months later they completed a weekly diary measure of daily hassles once a week for four weeks. Finally, at month 6, they completed self-report measures of depressive symptoms and life-events occurring since time 1. Results provided support for the importance of negative life events and daily hassles in the prediction of prospective depressive symptoms. Interpersonal-dependent life events were found to have a stronger relationship with prospective depressive symptoms than interpersonal-independent events and non-interpersonal life events. However, no differences were found in the strength of the association between different subtypes of hassles and prospective depressive symptoms. Response-Style and co-rumination were not found to statistically significantly interact with hassles or life events for any domain of stress, providing a lack of support for response-style or co-rumination as moderators of the stressor-depressive symptom relationship in the current sample. The findings do not provide support for the vulnerability-stress extension of the response styles theory in adolescents.

1. Introduction

1.1 Depression in Adolescents

Prevalence of major depressive disorder increases dramatically in the transition from childhood through adolescence to adulthood (Hankin et al., 2015; Costello, Foley, & Angold, 2006; Costello, Mustillo, Erkanli, Keeler & Angold, 2003; Lewinsohn, Rohde, & Seeley, 1998). Point prevalence rates in community samples rise from 1 to 3% in children, to 1-7% among adolescents, to 10% by age 18 (Avenevoli, Knight, Kessler & Merikangas, 2008; Costello, Erkanli & Angold, 2006). The presence of depressive symptoms and major depressive disorder in adolescence is associated with significant continuity through to adulthood as well as recurrence (Rutter, Kim-Cohen & Maughan, 2006).

Adolescence is also the period when gender differences in depression symptoms and episodes emerge. Until age 13, rates of depression are approximately equal across gender (Costello et al., 2002, Twenge & Nolen-Hoeksema, 2002). However in the transition from early to middle adolescence (ages 12 – 15 years), girls begin reporting higher levels of depressive symptoms (Angold, Erkanli, Silberg, Eaves & Costello, 2002; Twenge & Nolen-Hoeksema, 2002; Hankin et al., 2015, Ge, Conger & Elder, 2001) and disorders (Costello et al., 2003) , with females becoming twice as likely as males to experience an episode of depression by the end of adolescence, a difference which continues into adulthood (Avenevoli et al. 2008; Nolen-Hoeksema & Harrell, 2002, Costello et al., 2002). The striking rise in prevalence of depression and the emergence of the gender difference mark adolescence as a key period for examining the development of depression.

Depression in childhood and adolescence is also associated with difficulties in several areas of functioning including increased risk of future anxiety disorders, alcohol misuse, educational problems and unemployment, as well as problems with relationships with family and friends (Avenevoli et al., 2008; Fergusson & Woodward, 2002). Subclinical depressive symptoms in adolescents are also associated with functional impairment and negative outcomes similar to those of major depression (Gonzalez-Tejera et al., 2005). Given the negative outcomes associated with depression in youth and the increased risk of recurrence in adulthood there is an urgent need to better understand the risk factors for developing depressive disorders and symptoms in adolescence.

1.2 Stressful Life Events and Depression

One factor that has been consistently associated with depression is exposure to stressful life events, with increased exposure consistently predicting onset of depressive disorders (See

Hammen, 2005, and Kessler, 1997 for review). Within adolescent samples, longitudinal studies have found stressful life events to be related to onset of depressive episodes (Goodyer, Tamplin, Herbert, & Altham, 2000) and prospective depressive symptoms (Bijttebier, Raes, Vasey & Feldman, 2012; Hamlat et al., 2015; Ge et al., 2001; see Arnarson et al., 2016 for an exception).

The majority of research into stress and depression has used measures that conceptualise stress as a unitary construct. This approach assumes all types of stressful event exert a similar effect on depressive symptoms, yet certain types of event may be more likely to lead to depression than others. Some researchers have separated stressors into interpersonal stress, stressors involving relationships with others (peer, parent, sibling, teachers), e.g. an argument with a friend, versus non-interpersonal stress e.g. move to a new school (Hankin, Stone & Wright, 2010). Bastin, Mezulis, Ahles, Raes and Bijttebier (2015) in a multi-wave longitudinal study conducted over 1 year, found that although interpersonal and non-interpersonal stressors both predicted fluctuations in depressive symptoms, interpersonal stressors predicted greater increases in depressive symptoms across the one year study period than non-interpersonal stressors. Girls may be particularly vulnerable to the effects of interpersonal stress, with Shih, Eberhart, Hammen and Brennan (2006) finding that higher levels of interpersonal stress prospectively predicted depressive symptoms in girls but not boys.

Researchers have also distinguished between dependent versus independent events; dependent events being those that are at least partially dependent on a person's own behaviour or characteristics, e.g. failing a test, and independent events being those that occur outside the individual's control, e.g. death of a family member (Hankin et al., 2010). A study by Williamson, Birmaher, Anderson, Al-Shabbout & Ryan (1995) found that a sample of depressed adolescents were significantly more likely to have experienced a dependent stressful life event during the previous year compared to non-depressed controls, but the groups did not differ in the level of independent events experienced in the previous year. Kendler, Karkowski and Prescott (1999) found that dependent negative life events predicted depressive episode onsets in the month of exposure to the stressful event more strongly than independent events in a sample of female adults.

Whilst the majority of people who become depressed report a negative event shortly prior to the onset of the depressive episode, most people exposed to stressful events do not become depressed (Kessler, 1997; Hammen, 2005). This suggests that certain individual differences may make people more or less likely to develop depression following stress. Individual differences in the way people respond psychologically to stress and the corresponding feelings of dysphoria may be one such factor that increases susceptibility to increased depressive symptoms following

exposure to negative events. Identifying such maladaptive psychological responses to stressful events is important for developing interventions that target these responses or for directing future research (i.e. to understand and hence prevent the development of maladaptive psychological responses to stress).

1.3 Rumination as a Moderator of the Association between Stressful Events and Depressive Symptoms

One style of responding to sad or depressed mood that has been examined extensively in connection with depression is rumination. Rumination is defined as the tendency to passively and repetitively focus attention on one's own depressive symptoms and on understanding their causes and implications (Nolen-Hoeksema, 1991). The Response Styles Theory (Nolen-Hoeksema, 1991) proposes that individual differences in the way people cope with feelings of sadness may make them more vulnerable to developing depression. Specifically, the RST suggests that those who tend to ruminate in response to dysphoria are more likely to experience increased severity and duration of depressed mood. In contrast, individuals who distract themselves from depressive feelings, by engaging in thoughts and behaviours that divert their attention away from their mood e.g. taking exercise, watching a film (Nolen-Hoeksema, 1991), or who actively attempt to resolve or improve the situation (problem-solve), are theorised to be more likely to experience relief from these feelings. The RST was originally developed as an explanation of the gender difference in depression. It proposes that females are more likely to use rumination and men are more likely to use distraction in response to depressive mood, which they suggested could at least partly account for women's higher rates of depression (Nolen-Hoeksema, 1991).

Strong support for the RST comes from experimental studies in adults that use laboratory manipulations of rumination and distraction to examine their effects on mood in the short term. Inducing rumination in already dysphoric or depressed individuals increased depressed mood whereas inducing distraction in already dysphoric or depressed individuals produced relief from depressed mood (Lyubomirsky & Tkach, 2004; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Importantly, manipulating rumination and distraction in non-dysphoric individuals did not increase or reduce depressive mood respectively.

The RST has also been examined using questionnaire methods. Nolen-Hoeksema and Morrow (1991) developed the Response Styles Questionnaire to assess individual differences in self-reported tendency to ruminate or distract in response to depressed mood. Rumination as measured by the RSQ in adults has been associated cross-sectionally and longitudinally with depressive episodes and symptoms in clinical and non-clinical populations, even after controlling for baseline depression symptoms. However, evidence is more mixed regarding rumination

predicting the duration of depressive episodes. Higher levels of rumination have been found in women and this gender difference in rumination has been found to partially mediate the association between gender and depression (see Nolen-Hoeksema et al., 2008; Watkins 2008; Lyubomirsky & Tkach, 2004 for reviews).

The Response Styles Theory has also been investigated in younger samples. In cross-sectional studies with children and adolescents, higher levels of self-reported rumination are significantly associated with higher levels of self-reported depressive symptoms, interviewer-rated depressive symptoms and mother reported depressive symptoms (Abela, Vanderbilt & Rochon, 2004; Ziegert & Kristner, 2002; Kuyken, Watkins, Holden, & Cook, 2006; Abela, Brozina & Haigh, 2002; Burwell & Shirk, 2007).

Rumination has also been associated with prospective increases in depressive symptoms, while controlling for initial levels of depression symptoms, in early and middle adolescence (Abela et al., 2002; Abela, Aydin & Auerback, 2007; Calvete, Orue & Hankin, 2015; Hankin, 2009) and late adolescence (Schwartz and Koenig, 1996). Higher levels of rumination have also been associated with increased likelihood of future episodes of major depression, an effect that was maintained after controlling for current depressive symptoms and previous major depressive episodes (Nolen-Hoeksema, Stice, Wade & Bohon, 2007; Abela & Hankin, 2011). Abela, Parkinson, Stolow and Starrs (2009) found that rumination was associated with change in hopelessness depressive symptoms, but not depressive symptoms more generally.

Rood, Roelofs, Bögels, Nolen-Hoeksema and Schouten (2009) conducted a meta-analysis to examine the association of response-styles and depression symptoms cross-sectionally and longitudinally in non-clinical samples of children and adolescents. The meta-analysis suggested that effect sizes for cross-sectional associations between rumination and depression are moderate to strong. Moderate effect sizes were found for longitudinal associations between rumination and depressive symptoms, however when controlling for baseline depressive symptoms these effects reduced to a modest size. Pooled effect sizes for cross-sectional associations between distraction and depressive symptoms were modest and results did not support distraction as a significant predictor of depressive symptoms across time.

In line with the emergence of gender differences in rumination emerging during adolescence, studies using child and early adolescent samples generally find no gender difference in self-reported rumination (Abela et al, 2007, Abela, Hankin, Sheshko, Fishman & Stolow 2012; Abela & Hankin, 2011; Broderick & Korteland 2004; Stange, Hamilton, Abramson & Alloy, 2014, see Ziegert & Kristner, 2002 for an exception), whereas studies using middle to late adolescent samples find support for higher levels of rumination reported in girls compared to boys (Hankin,

2009; Abela et al., 2009; Schwartz & Koenig, 1996). Furthermore, in support of gender differences in rumination explaining at least in part the gender difference in depressive symptoms, Grant et al., (2004) found evidence that rumination mediated the relationship between gender and depressive symptoms cross-sectionally. Although Hankin (2009) found that rumination was able to account for gender differences in initial depressive symptoms, but not for changes in depressive symptom levels over time.

1.4 Stress-Vulnerability Models of Depression

Researchers (e.g. Abela et al., 2012) have begun to conceptualise rumination within a vulnerability-stress framework, which hypothesizes that people who use maladaptive responses to stressful events and the associated depressive feelings (i.e. rumination) will be more vulnerable to experiencing increased depressive symptoms following stressful life events. Studies investigating rumination from a vulnerability-stress perspective examine whether the stress-depression relationship is stronger for those who report higher levels or rumination, namely, whether the stress-depression relationship is moderated by rumination.

Studies investigating rumination within a vulnerability-stress context have found mixed results. In a longitudinal, multi-wave study over two years in a sample of early to mid-adolescents, rumination was found to moderate the association between occurrence of negative events and future depressive episodes and change in depressive symptoms (Abela & Hankin, 2011). Adolescents reporting higher levels of rumination and negative life events experienced increased prospective levels of self-report and clinician-rated depressive symptoms compared to those reporting low levels of negative events. Levels of negative events were not associated with prospective self-report or clinician-rated depressive symptoms for adolescents reporting low levels of rumination. The same pattern of results was found in the prediction of onsets of new major depressive episodes (assessed by trained interviewers) over the course of the study. There were no gender differences in the interactive effect.

Two further studies found support for an interactive effect of rumination and negative-events in adolescents. Individuals with a greater tendency to ruminate who reported increased life events experienced greater increases in depressive symptoms, controlling for earlier depression symptoms, than those reporting low rumination scores (Hankin, 2009; Skitch & Abela, 2008). Taken together these results provide initial support for a ruminative response style increasing adolescents' vulnerability to depressive symptoms following the occurrence of negative events.

However, several other studies have failed to find a statistically significant moderating effect of rumination on the relationship between negative events and depressive symptoms (Abela et al., 2009; Schwartz & Koenig, 1996; Bijttebier, et al., 2012; Cohen, Young, Gibb, Hankin & Abela,

2014; Hamlat et al., 2015; Paredes & Zumalade, 2015). Gender differences in the interactive effects were either not explored/reported (Abela et al., 2009; Bijttebier et al., 2012; Schwartz & Koenig, 1996), or were not significant (Cohen et al., 2014; Hamlat et al., 2015; Paredes & Zumalade, 2015).

1.5 Examining Stress-Vulnerability Models with Different Domains of Stressful Events

One reason for the mixed findings with regard to the moderating effect of rumination on the stress-depressive symptom relationship may be that all of the studies discussed thus far have examined stress as a unitary construct, yet rumination may be more likely to lead to depression following certain types of stressor than others. Just three studies have explored whether rumination moderates the longitudinal relationship between stressors and depressive symptoms for different domains of stressor in adolescents. Bastin et al. (2015) in a multi-wave longitudinal study conducted with a group of early to middle adolescents over a year, found that rumination significantly moderated the effect of interpersonal life events but not non-interpersonal life events on depressive symptoms. The relationship between interpersonal stress and depressive symptoms was stronger for participants with high levels of rumination versus those with low levels of rumination. This interaction applied equally well to boys and girls. However, in a sample of late adolescents, Cox, Funasaki, Smith & Mezulis, (2012), using a different measure of stressors that included both daily hassles and major life events, found that brooding, a form of rumination, significantly moderated the effects of stressors on depressive symptoms for independent, dependent and non-interpersonal but not interpersonal stressors.

However, the findings from one study suggest it may be important to distinguish between interpersonal events that are dependent on the individual in some way versus those that independent of the individual when examining rumination from a stress-vulnerability perspective. Strange et al., (2014) found that rumination interacted with dependent-interpersonal life events to predict prospective symptoms of depression but not achievement or independent-interpersonal life events. There were no gender differences in these interaction analyses.

1.6 Measurement of Stress

The majority of studies described above that explore rumination as a moderator of the relationship between stress and depressive symptoms use retrospective self-report measures of stressful events. This method requires that participants retrospectively recall the occurrence of negative events over a given time period (which in the aforementioned studies ranged from 1 – 9 months) using self-report checklists. However, the reports gathered in this way may be biased by mood-congruent memory recall for individuals with higher levels of depressive symptoms

(Hankin, Mermelstein, & Roesch, 2007), especially for measures using longer recall periods. Interview methods are an attempt to reduce this bias, but this method is unable to totally avoid recall bias, especially over longer periods of time. In addition, interview methods are time-consuming and labour intensive, which is often not feasible where large numbers of participants are required. Measures with shorter time periods e.g. weekly, are likely to reduce recall bias compared to those using longer periods of time. Furthermore, asking participants to retrospectively recall events over months rather than days or a week may mean that relatively more minor daily hassles (e.g. arguments with peers or parents, getting told off by a teacher) are forgotten

One study that used a measure of "daily hassles" that required participants to recall events over much shorter time periods, suggests that these smaller, less significant events are also relevant in a stress-vulnerability model of depression. Abela et al., (2012) measured stressors every five to nine days over an eight-week period, with a total of six assessments. They found a significant interaction between rumination and hassles predicting fluctuations in depressive symptoms over time. The relationship between hassles and depressive symptoms was significantly greater in adolescents with high levels of rumination than in those with low levels of rumination. Abela et al. (2012) also found a gender difference in the rumination x hassles effect on depressive symptoms such that rumination was more strongly associated with increases in depressive symptoms following the occurrence of hassles in girls than in boys. Driscoll, Lopez and Kistner (2009) similarly found that higher levels or rumination relative to distraction/problem solving and high levels of hassles were associated with increased risk for depressive symptoms over time. The findings from Abela et al., (2012) and Driscoll et al., (2009) suggest that future research into stress-reactivity models of depression needs to include measures of hassles since they are also relevant in the study of the effects of rumination on stressors in the prediction of depressive symptoms.

In summary, the previous literature is limited by its reliance on measures of stress that conceptualise stressors as a unitary construct and focus on major life events rather than daily hassles. The current study will therefore examine the role of rumination following different domains of stressor and will include a measure of hassles as well as life events. Although Cox et al. (2012) used a measure that included hassles as well as life events they did not further break down interpersonal events according to whether they were dependent or independent of the individual, which findings from Stange et al. (2014) suggest may be important when examining rumination in response to stressors. Furthermore Cox et al. (2012) used a sample of late adolescents and the current study will examine the effect of rumination following different types of stressor in a sample of early adolescents.

1.7 Measurement of Rumination

Previous research into the response styles theory has examined each of the response styles (rumination and distraction/problem solving) separately. Abela et al., (2007) highlight that this approach assumes that individuals consistently use one of the response styles and that those who score highly on rumination will be low scorers on distraction and problem solving, i.e. that the response styles are inversely related. However, research with adults and adolescents has found that rumination and distraction/problem solving are not inversely associated but are in fact orthogonal or positively correlated (see Abela et al., 2007 for review). This implies that individuals do not use a consistent response style and hence the traditional approach of examining response styles separately may be problematic because it does not take into account the relative contribution of both response styles. For example, individuals reporting high levels of rumination and low levels of distraction/problem solving would be equivalent to those reporting high levels of rumination and high levels of distraction/problem solving. Abela et al., (2007) proposed that examining response styles as a ratio score (dividing rumination scores by distraction/problem solving scores) was a preferable method because it takes into consideration the balance of response styles and provides a measure of an individual's level of rumination relative to their level of distraction and problem solving. High ratio scores represent a greater tendency to use a ruminative response style compared to distraction/problem solving.

In support of their hypotheses, Abela et al. (2007) in a high risk sample of adolescents found that rumination was not inversely related to distraction/problem solving and in fact found them to be orthogonal constructs. Response style ratio scores were more strongly associated with concurrent and increases in depressive symptoms than were individual rumination or problem solving/distraction scores. These results suggest that knowing the degree of balance between adaptive (distraction/problem solving) and maladaptive response styles (rumination) may be a more accurate way of capturing and individual's vulnerability to depression in terms of the RST. These results were replicated within a community sample of adolescents (Roeloffs et al., 2009) and within a stress-vulnerability framework, where response style ratio scores were found to interact with stress to predict changes in depressive symptoms in adolescents (Driscoll et al., 2009). These results support the use of ratio scores for investigating the RST and in line with Abela et al's recommendation, the current study will utilise a ratio score to examine response styles.

1.8 Rumination as an Interpersonal Process: Co-rumination

Rumination is an intrapersonal process, but it can also occur in an interpersonal context. The concept of co-rumination (Rose, 2002) is defined as non-solution-focused discussion that focuses

on speculating and revisiting problems and the negative feelings associated with these problems within dyads in a close relationship (White and Shih, 2012). Co-rumination seems to emerge across late-childhood into adolescence (Rose, 2002; Hankin et al., 2010), overlapping with the increase in depression during this developmental period (Costello et al., 2006). Co-rumination has both positive and negative associations. The positive being an association with perceived friendship quality and relationship closeness (Rose 2002; Calmes & Roberts, 2008). The negative being its repetitive, unproductive nature and the focus on problems (Rose, Carlson & Waller, 2007). There is a moderate positive relationship between rumination and co-rumination, and factor analytic investigations suggest the constructs are related but distinct (Rose, 2002; Calmes & Roberts, 2008).

In adolescent samples, co-rumination has been associated with a lifetime history of depressive disorders (Stone, Uhrlass & Gibb, 2010) and has also been found to predict time to onset of depressive episode and severity of depressive episode, whilst controlling for baseline depression and rumination (Stone, Hankin, Gibb & Abela, 2011). Stone et al., 2011 found a significant relationship between co-rumination and depression symptoms, but this did not remain significant once baseline depression and rumination were controlled for. This is supported by Hankin et al., (2010), who found that co-rumination was significantly associated with fluctuations in depressive symptoms over time. Although, Starr and Davila (2009) found co-rumination to be positively correlated with concurrent depressive symptoms, but not longitudinal changes in depressive symptoms, in a sample of early adolescent girls.

A meta-analysis (Spendelow, Simonds & Avery, 2017) exploring the relationship between co-rumination and internalizing problems in children, adolescents and young adults found small to moderate cross-sectional associations between co-rumination and internalizing symptoms. These effect sizes are smaller than the effect sizes for the rumination-depression association reported by Rood et al. (2009). However, Rose (2002) proposes that a smaller effect would be expected given that co-rumination has adaptive as well as maladaptive associations.

Few studies have examined co-rumination within a vulnerability-stress context amongst adolescents. Haggard, Robert and Rose (2011) found that the stress x co-rumination interactive effect differed across gender in an adult sample. For men, co-rumination interacted with stress to predict concurrent depressive symptom levels, such that higher levels of co-rumination and stress were associated with lower levels of depressive symptoms. However, the stress x co-rumination association was not significant in women. This suggests that co-rumination may have a protective effect for males when they experience stressful events and that the relationship between stress, co-rumination and depressive symptoms may be different for males and females.

However, these results may not generalise to younger samples. White and Shih (2012) found that co-rumination moderated the association between daily stressful life events and daily mood in a sample of college students. The association between hassles and depressed mood was stronger for students with higher levels of co-rumination than lower levels.

Investigating different domains of stressor may also be important in the context of co-rumination. For instance, co-rumination about dependent and social events but not independent and non-social events was found to prospectively predict depressive symptoms in a sample of late adolescents (Nicolai, Laney & Mezulis, 2013). Furthermore, Bastin et al. (2015) investigated whether co-rumination moderated the association between stressful life events and depression in an adolescent sample. They found that co-rumination did not significantly moderate the stress-depression relationship for interpersonal or non-interpersonal events, but that co-rumination interacted with gender to moderate the interpersonal stress-depression relationship such that girls who experienced higher levels of interpersonal stress developed increased depressive symptoms if they had higher levels of co-rumination. This pattern was reversed for boys, with higher likelihood of developing depressive symptoms following stressful events if they had lower levels of co-rumination rather than high. This result adds support to Haggard et al.'s (2011) finding and their suggestion that co-rumination may have a buffering effect against stress for males. Given that rumination has been found to exert differential effects on interpersonal stressors depending on whether they are dependent or independent of the individual (Stange et al., 2014), co-rumination may also affect interpersonal stressors differentially depending on whether they are dependent or independent. Hence as well as examining the effect of rumination on the stressor-depression association for different domains of life events and hassles, the current study will also explore the role of co-rumination in this context.

1.9 The Current Study

The majority of studies have examined the stress-vulnerability model of depression with stress as a unitary construct. Only three studies that we are aware of have explored rumination as a moderator of the longitudinal stressor-depressive symptom relationship for different domains of life events. Two of these compared interpersonal to non-interpersonal life-events or dependent to independent life-events (Bastin et al., 2014; Cox et al., 2012), but only one of these (Stange et al., 2014) has separated life events into interpersonal and non-interpersonal events and then further separated these sub-groups according to whether they are dependent or independent. Furthermore, Bastin et al. (2015) and Stange et al. (2014) use self-report checklist methods of life events with relatively long recall periods which may be biased by mood-congruent memory recall

for individuals with higher depressive symptoms and may also lead to forgetting of more minor daily hassles. Therefore, as well as a self-report, retrospective measure of life events, this study will ask participants to report stressors over several shorter time periods. This will enhance recall of less significant daily hassles and reduce recall bias. The current study will also explore co-rumination as a moderator of the stressor-depressive symptom relationship.

In summary, the current study is the first to examine response-style (ratio of rumination relative to distraction and problem solving) and co-rumination as moderators of the longitudinal stressor-depressive symptom relationship for different domains of hassles as well as life events in a sample of early adolescents.

The study aims to answer the following two questions:

1) Does the level of negative life events and/or daily hassles predict changes in depressive symptoms over time and does this relationship differ depending on the type of stressor (i.e. dependent versus independent and non-interpersonal versus interpersonal)? It is hypothesised that interpersonal-dependent stressors will be a particularly strong predictor of depressive symptoms over time.

2) Do response style (rumination relative to distraction and problem solving) and co-rumination moderate the relationship between stress and depression and does this relationship differ depending on the type of stressor?

2. Methods

2.1 Design

A prospective, longitudinal, multi-wave questionnaire study was carried out. The study consisted of three stages of data collection over 6 months. At Baseline (Time 1), depressive symptoms, response styles and co-rumination were measured. At month 5 (Time 2), participants completed a weekly diary measure of daily hassles once a week, for four weeks. At month 6 (Time 3), depressive symptoms were measured again and participants completed a retrospective measure of life events covering the last 6 months (events occurring between baseline and Time 3).

2.2 Ethical approval and consent procedures

The current study was part of a joint project (data collection and data entry shared) examining the reciprocal relationships between cognitive vulnerabilities, stress, depression and irritability in adolescence (details of all measures collected at each time point are provided in Appendix 1).

Full ethical approval for the research project was granted by the King's College London Psychiatry, Nursing and Midwifery Research Ethics Subcommittee (Reference: HR-15/16-1919).

Data collection was carried out in schools. Researchers attended year assemblies to explain the project and hand information sheets to the students for themselves and their parents. An opt-in consent procedure was used for the students and an opt-out procedure for parents. Information sheets and opt-out parental consent forms were sent to parents by post and were also given to students to hand to their parents/carers. Parents/carers were given two weeks to opt-out on behalf of their child and were provided with three different methods for opting out: telephone, email and post (stamped, addressed return envelopes were provided).

At each time point researchers attended form periods and/or allocated humanities lesson and provided reminder information about the research project. Adolescents who agreed to participate signed assent forms. Those who did not wish to participate or who did not meet eligibility criteria were asked to read quietly. Young people signed opt-in assent forms at each time point and were free to withdraw at any point during the study.

2.3 Participants

All students from years 8 and 9 of a single large secondary school in South London were invited to participate. The project was explained to young people in school assemblies. Having English as a second language or a learning disability diagnosis were exclusion criteria from the research project.

There were 251 students on the school register for Years 8 and 9. At Time 1, 165 students (94 (57.0%) male and 71 (43.0%) female) completed baseline self-report measures. Non-participation was due to absence on the day of testing, young-person non-assent, parent opt-out and incomplete data. At baseline participants were aged between 12 years 2 months and 14 years 5 months (Mean age = 13.22 years, Standard Deviation = .633). 54.5 % of adolescents identified their ethnicity as Black, 18.8 % as White, 6.7% as Asian, 14.5% as Mixed and 4.8% as Other. The gender and ethnicity distribution of the final sample was representative of the school population (details are provided in Appendix 3).

Of the students that participated at Time 1, 143 students (81 (56.6%) male and 62 (43.4%) female), went on to complete at least 3 waves of the Time 2 hassles measures and 156 (87 (55.8%) male and 69 (44.2%) female) participated at Time 3. Independent t-tests were used to compare baseline self-report data for those who completed measures at all three time-points with those who did not complete either Time 2 or Time 3. There was no significant difference in age ($t(163) = 1.553$, $p=.122$), Time 1 depressive symptoms ($t(158)=0.96$, $p=0.34$), response-style ratio score

(t(161)=0.90, p=.38) or co-rumination (t(154)=0.02, p=0.98) in those that completed all three time points and those that did not complete time point two or three.

A Pearson's Chi-Squared test was carried out to assess whether incompletion at Time 2 or 3 was associated with gender or ethnicity. There was no significant association between gender ($\chi2(1)=0.74$, p=0.39) or ethnicity ($\chi2(4)=1.32$, p=0.86) and whether participants did not complete Time 2 or Time 3 data. The final sample used in the analysis comprised of 156 students.

2.4 Sample Size Estimation

Power calculations, using correlations and effect sizes reported in Strange et al. (2014), were used to provide an estimate of the appropriate sample size. The power analysis for the first research question suggested that in a multiple regression between dependent-interpersonal stress and depressive symptoms, while controlling for baseline depressive symptoms and other covariates, a sample size of 82 would be needed to ensure 80% power to detect an effect which explains 9% of the variance at an alpha level of 0.05. The power analysis for the second research question suggested that, based on an effect size of $f^2 = 0.4$ (for the dependent-interpersonal life events x rumination interaction effect predicting prospective depressive symptoms), in order to obtain 80% power for a single parameter interaction term, using an alpha level of 0.05, given three other predictors, a sample size of 199 would be needed.

2.5 Procedure

There was three data collection points. At Time 1, participants completed the following self-report questionnaires in the order presented: Child Depression Inventory Second Edition (CDI-2); Children's Response Style Questionnaire (CRSQ); Co-Rumination Questionnaire (CRQ). Five months after baseline, at Time 2, participants completed the Child Hassles Scale (CHS) once a week over the four weeks. Six months following baseline, at Time 3, Participants completed the following questionnaires in the following order: CDI, Adolescent Life Events Questionnaire (ALEQ).

At all time points questionnaires were given to children in whole form groups either in form periods or allocated humanities lessons. Students that did not finish completing the questionnaires in the allocated time or those who required extra support were provided extra time and 1:1 support to complete the questionnaires.

All data was entered by researchers into SPSS version 24 (IBM Corp., 2016). Data checks were performed by selecting a random 10% subset of participants at each time point and manually checking the accuracy of the data entered. Total scores or subscale scores were calculated for all

measures. Mean replacement was used to account for missing data, where less than 6% of items on a measure were missing.

2.6 Measures

The Children's Depression Inventory 2nd Edition, (CDI-2; Kovacs & Staff, 2003) is a 28-item measure to assess depressive symptoms levels, designed for use with children and adolescents aged between seven and 17 years. For each item participants select one of three options that best fits with how they have been feeling over the last two weeks. An example of the three response options for one item are: "I am sad once in a while", "I am sad many times", or "I am sad all the time". Each item has an associated score ranging from 0 to 2. Responses are summed to form a total depression score ranging from 0 to 54, with higher scores indicating greater levels of depressive symptoms. The CDI-2 demonstrates good internal consistency (Kovacs, 1992; Helsel & Matson, 1984) and acceptable test-retest reliability (Finch, Saylor, Edwards & McIntosh, 1987). It is able to accurately discriminate youth with major depressive disorder from controls matched on age, gender, ethnicity, generalised anxiety disorder, conduct/oppositional defiant disorder and attention deficit hyperactivity disorder and correlates with the Beck Depression Inventory-Youth version (Bae, 2012). The CDI-2 demonstrated good internal consistency for this sample with Cronbach's alphas of 0.90 and 0.88 scores at baseline and follow-up respectively.

The Children's Response Styles Questionnaire (CRSQ; Abela et al., 2002) is a 25-item self-report questionnaire that measures responses to sad mood. The measure is comprised of three scales, representing three different responses to sadness: rumination, distraction or problem solving. For each item children are asked to rate how frequently they respond to a sad mood with the particular response on a four point scale, ranging from 1 (almost never) to 4 (almost always). An example item from the rumination subscale is "when I am sad, I go away by myself and think about why I feel this way", from the distraction subscale is: "when I am sad, I watch TV or play video games so I don't think about how sad I am", and from the problem-solving subscale is: "when I am sad, I ask a friend, parent, or teacher to help me solve my problem". Subscale items are summed and higher scores indicate a greater tendency to engage in rumination or distraction/problem solving when feeling sad. Abela et al., (2007) recommends using a ratio score for measures of response style, to reflect rumination relative to distraction. Hence, the current study uses ratio scores to measure participants' response styles, where higher ratio scores indicate a higher likelihood of engaging in rumination relative to distraction and problems solving. The CRSQ has shown good validity and moderate internal consistency (Abela et al., 2004, Abela et al., 2007). Chronbach alpha's for the rumination and distraction-problems solving scales for

this sample were 0.92 and 0.81 respectively, demonstrating good internal consistency of the rumination and distraction-problem solving scales.

The Co-rumination Questionnaire (CRQ; Rose, 2002) is a 27-item self-report questionnaire that measures the extent to which youth typically co-ruminate with their closest, same-sex friend (e.g. "when one of us has a problem, we talk to each other about it for a long time") using a five-point rating scale, ranging from 1 (not at all) to 5 (really true). The mean score is calculated to provide a measure of co-rumination. The CRQ has demonstrated excellent internal consistency and good test-retest reliability and validity (Rose et al., 2007). For this sample Cronbach's alpha was 0.96 demonstrating high internal reliability of the CRQ for this sample.

The Adolescent Life Events Questionnaire (ALEQ; Hankin & Abramson, 2002) is a self-report measure of a broad range of negative life events that can occur among adolescents. It covers 57 negative events in the areas of family (e.g. "A close family member had a significant medical or emotional problem"), relationships (e.g. "you found out your boyfriend/girlfriend was cheating on you"), school (e.g. "you got into trouble with the teacher or principle"), and friendships (e.g. "a close friend died"). Participants are asked to rate how often each of the negative events has occurred to them over the past 3 months on a Likert scale ranging from never (0) to always (4). The ALEQ demonstrated good reliability and validity in past research (Hankin, 2008; Hankin et al., 2010).

In the current study, participants were asked to indicate how often each of the negative events had occurred to them since baseline data collection (the past 6 months), using the Likert scale described above. These scores were converted to occurrence scores, on a dichotomous (yes = 1, no = 0) scale as to whether the event occurred over the previous 6 months or not.

The negative life events included in the ALEQ were categorized into interpersonal and non-interpersonal event domains as well as independent versus dependent types of events. The coding scheme was taken from that used in Hankin et al., (2010) with permission from the authors. This resulted in 39 interpersonal events, 26 of which were coded as dependent and 13 as independent and 11 non-interpersonal events, all of which were categorized as dependent. Seven events were not coded as interpersonal or non-interpersonal by Hankin et al., (2010) and were not included in the categorized items. Examples for the interpersonal-dependent events (I-D Events) include: "You had an argument with a close friend," "Your boyfriend/girlfriend criticized you,". Examples of interpersonal-independent events (I-I events) are "A close friend moved

away" and "close family member (parent, brother, sister) died." Non-interpersonal event (N-I event) examples include "Did poorly on, or failed, a test or class project," and "You had to do chores or work you didn't want to do."

Cronbach's alphas, in the current sample, for the total ALEQ was 0.94, for the I-D domain items was 0.91, for the I-I items was 0.69 and for the N-I items was 0.78.

The Children's Hassles Scale (CHS; Kanner, Feldman, Weinberger & Ford, 1987) is a self-report questionnaire assessing hassles that children and young people typically experience. It consists of 25 hassles and in the standard administration instructions participants are asked to indicate which hassles occurred in the last month and to rate the subjective intensity of the impact of the stressor (whether they "didn't feel bad", "felt sort of bad", "or felt very bad" as a result of the hassle). Three summary scores can be generated from the CHS: 1) a count of the number of hassles that occurred in the last month, yielding a score that can range from 0 to 25; 2) a count of the number of hassles rated as either "sort of bad" or "very bad" and 3) a total perceived intensity score. The CHS has good internal consistency and was associated with greater emotional distress and perceived interpersonal problems (Kanner et al., 1987).

The current study was attempting to measure the occurrence of events, rather than the perceived intensity of the events and as such only the first summary score, whether the event occurred or not was used in the current study. In the current study the participants were asked to rate whether the hassle had occurred in the past week rather than the past month.

The hassles items were coded into interpersonal and non-interpersonal hassles and then separated further into dependent and independent hassles by three researchers independently. Coding was based on the definitions of dependent/independent and interpersonal/non-interpersonal events used to code the ALEQ in Hankin et al., (2010). Agreement between all three coders was 84% and discrepancies were discussed until consensus was reached. This resulted in three different subscales of hassles: interpersonal-dependent hassles (I-D hassles; five items), interpersonal-independent hassles (I-I hassles) (eight items), non-interpersonal hassles (N-I hassles; 12 items). Examples of I-D hassles are "you got into a fight with another kid" and "your teacher was mad at you because of your behaviour". Examples of I-I hassles are "your mother or father got sick" and "you were punished for something you did not do". N-I hassles "you lost something" and "your school work was too hard".

The items within each subscale were summed for each of the 4 weeks to form a total score for each domain of hassles for each week. Mean scores for each domain across the four weeks were then created to form mean weekly hassles scores, for each stress domain. Where participants

were missing hassles data for one or more weeks, mean replacement was used where at least three of the four weeks of hassles data had been collected.

In the current study, Cronbach's Alphas across the four weeks ranged from 0.84 to 0.87 for the items making up the total hassles scores, from 0.65 to 0.75 for the I-I hassle items, from 0.40 to 0.62 for the interpersonal-dependent domain items and from 0.72 to 0.77 for the N-I hassle items. Internal consistency was good for total hassles, fair for interpersonal-independent and non-interpersonal hassles but poor for interpersonal-dependent hassles.

3. Results

3.1 General Data Analytic Approach

Regression analyses were used to test all the study hypotheses (see below for details). Assumptions associated with multiple regression were assessed for each regression model (Laerd Statistics, 2015; please see Appendix 4 for a summary of the diagnostic analyses). The relationship between the predictor variables (and their composite) and the dependent variable was approximately linear for all regression equations, assessed using visual inspection of partial regression plots and a plot of studentized residuals against the predicted values of the dependent variable. The assumption of normality of errors (residuals) was met for all regression equations. The assumption of homoscedasticity of residuals, as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values was met. There were no issues of multicollinearity, as assessed by tolerance values greater than 0.1. The Durbin-Watson Statistic was used to assess for independence of errors, this assumption was met for all regression analyses. Standardized Residuals were examined to identify possible outliers. Cases with Standardized Residuals greater than 3.00 were investigated as possible outliers. Leverage Points and Cook's distances were examined to identify cases with high leverage points or highly influential points. Where outliers, high leverage points (leverage scores of above 0.5 were considered to have undue influence over the model (Laerd Statistics, 2015) or Cook's distances of above 1 (Laerd Statistics, 2015) were identified, the analyses were re-run with the relevant cases excluded, to check that the results did not differ depending on whether the case was included or not. Results of these re-run analyses are detailed below with the relevant regression analysis.

3.2 Descriptive Statistics and Correlations

Means, Standard-deviations and inter-correlations between all study variables are presented separately for males and females in Table 1. Age did not correlate significantly with depressive symptoms at baseline or Time 3, or with any of the predictor variables other than interpersonal-

dependent hassles for males and non-interpersonal hassles for females. Depressive symptoms at baseline significantly positively correlated with response style, all hassles measures and Time 3 depressive symptoms in males and females. Baseline depressive symptoms were associated with life events in females but not males. Response style also significantly positively correlated with Time 3 depressive symptoms but not co-rumination in both genders. In males, response style correlated with all three domains of hassles. Co-rumination was not significantly correlated to baseline or Time 3 depressive symptoms. In females, co-rumination was significantly positively correlated with non-interpersonal life events and in males it was significantly correlated with interpersonal-independent hassles. All hassles and life-events variables were significantly positively correlated to Time 3 depressive symptoms. Independent samples t-tests were used to assess for mean differences in variables across gender, these are also reported in Table 1. Girls reported statistically significantly higher levels of Time 1 depressive symptoms, and rumination (versus distraction). There was no significant difference in the reported levels of Time 3 depressive symptoms or any of the domains of hassles or life events between genders.

A one-way ANOVA was used to test for mean differences in key variables across ethnic groups (White, Black, Asian, Mixed, Other). There were no statistically significant differences between ethnic groups in mean levels of Time 1 depressive Symptoms ($F(4,154)=0.24$, $p=0.91$), Response Style ($F(4,157)=0.45$, $p=0.78$), co-rumination($F(4,151)=0.60$, $p=0.66$) and Time 3 depressive Symptoms ($F(4,150)=0.45$, $p=0.78$). There were also no differences between ethnic groups on any of the stress variables (Time 2 interpersonal-dependent hassles (I-D, hassles; $F(4,137)=0.81$, $p=0.52$), Time 2 interpersonal-independent hassles (I-I hassles; $F(4,136)=0.69$, $p=0.60$), Time 2 non-interpersonal hassles (N-I hassles; $F(4,134)=0.78$, $p=0.54$), Time 3 interpersonal dependent life events (I-D life events; $F(4,151)=0.67$, $p=0.62$), Time 3 interpersonal independent life events (I-I life events; $F(4,150)=0.72$, $p=0.58$), Time 3 non-interpersonal life events (N-I life events; $F(4,151)=0.40$, $p=0.81$) and Time 3 depressive symptoms ($F(4,150)=0.45$, $p=0.78$)) .

Table 2. Descriptive Statistics and Correlations Between Primary Study Variables.

	1	2	3	4	5	6	7	8	9	10	11
1. Age	-	0.22	0.16	0.00	-0.27*	-0.17	-0.27*	-0.08	-0.10	-0.06	0.19
2. T1 CDI	-0.03	-	0.73**	0.07	0.30*	0.42**	0.28*	0.43**	0.48**	0.44**	0.69**
3. T1 CRSQ Ratio	-0.02	0.66**	-	0.19	0.15	0.10	0.11	0.18	0.17	0.33**	0.41**
4. T1 Co-rum	-0.13	0.03	-0.03	-	0.01	0.03	0.10	0.06	0.07	0.24*	-0.03
5. I-D CHS	-0.24*	0.38**	0.40**	0.19	-	0.65**	0.60**	0.69**	0.45**	0.64**	0.51**
6. I-I CHS	-0.21	0.24*	0.28*	0.27*	0.67**	-	0.76**	0.72**	0.62**	0.72**	0.61**
7. N-I CHS	-0.09	0.37**	0.31**	0.17	0.65**	0.68**	-	0.43**	0.52**	0.67**	0.43**
8. I-D ALEQ	-0.11	0.11	0.11	0.08	0.43**	0.54**	0.52**	-	0.61**	0.75**	0.59**
9. I-I ALEQ	-0.03	0.09	0.16	0.02	0.29*	0.52**	0.30**	0.64**	-	0.54**	0.46**
10. N-I ALEQ	-0.08	0.14	0.06	0.04	0.30**	0.43**	0.49**	0.77**	0.46**	-	0.52**
11. T3 CDI	-0.04	0.61**	0.38**	-0.03	0.39**	0.35**	0.48**	0.36**	0.27*	0.23*	-
Mean (SD) Girls	13.25 (0.60)	11.60 (9.50)	1.10 (0.51)	2.57 (0.82)	1.70 (0.97)	1.79 (1.47)	5.51 (2.22)	6.09 (5.19)	1.96 (1.86)	3.72 (2.69)	9.19 (7.74)
Mean (SD) Boys	13.19 (0.66)	8.00 (7.35)	0.93 (0.51)	2.05 (0.75)	1.92 (1.15)	1.60 (1.54)	4.95 (2.36)	5.75 (5.34)	1.58 (2.03)	3.40 (2.60)	7.56 (6.70)

	1	2	3	4	5	6	7	8	9	10	11
Gender difference (*t*) (df)	-0.65 (163)	-2.70** (158)	-2.01* (161)	-4.09 (154)	1.21 (141)	-0.75 (140)	1.41 (138)	-0.41 (154)	-1.19 (153)	-0.76 (154)	1.40 (153)

**p<0.01, *p<0.05.

Note: Correlations below the diagonal are for males and correlations above the diagonal are for females. CDI = Children's Depression Inventory, CRSQ = Children's Response Styles Questionnaire, CHS = Children's Hassles Scale, ALEQ = Adolescent Life Events Questionnaire, I-D CHS = interpersonal-dependent subscale of Child Hassles Scale (CHS), I-I = interpersonal-independent subscale of the CHS, N-I = non-interpersonal subscale of the CHS, I-D ALEQ interpersonal-dependent ALEQ, I-I ALEQ= interpersonal-independent subscale of the ALEQ, N-I ALEQ = non-interpersonal dependent Subscale of the ALEQ.

3.3 Question 1: Hassles and Life Events as Predictors of Prospective Depressive Symptoms

The first aim of the study was to examine whether the level of negative life events and/or daily hassles experienced by a sample of adolescents predicts changes in depressive symptoms over time and whether this relationship differs depending on the type of stressor. Multiple regression equations were used to explore this question. Separate regression equations were created for each stress variable, with Time 3 depressive symptoms as the dependent variable (outcome) and the stress variables as the independent variable (predictor). Age, gender, and Time 1 depressive symptoms were also included in the regression equation as covariates to control for baseline differences between participants in depressive symptoms and the effects of age and gender on Time 3 CDI. Initially, predictors and control variables were entered simultaneously into the regression equation. Following this a hierarchical regression was conducted with any statistically non-significant variables from the simultaneous entry regression removed, to test the contribution of the stress variable above and beyond the contribution of the control variables. The hierarchical regressions were performed in two steps. Control variables were entered at Step 1 and the stress variable at Step 2. Predictor variables were standardized to enable comparison of the regression coefficients and their associated confidence intervals across the different regression models.

Age and gender did not make statistically significant contributions to the prediction of Time 3 depressive symptoms in the simultaneous entry regression analyses for any of the stress variables. All of the stress variables were significant predictors of Time 3 CDI in the simultaneous entry models while controlling for age, gender, and Time 1 depressive symptoms. Therefore, hierarchical regression models were performed for each stress variable independently (entered as the predictor in Step 2) and only Time 1 depressive symptoms was retained as a covariate (entered at Step 1). Examining standardized residuals for all regression equations identified 3 possible outliers. The analyses were run with the 3 possible outliers excluded, there was no difference in the pattern of results with or without possible outliers and therefore results reported here are with these cases included.

Prospective Effects of Life Events on Time 3 Depressive Symptoms.

The levels of life events reported by adolescents in all three domains were found to statistically significantly predict Time 3 self-reported depressive symptoms, whilst controlling for Time 1 depressive symptoms. The inclusion of life events in the hierarchical multiple regression model (Step 2) significantly and independently predicted T3 CDI for D-I life events (ΔR^2=0.08, F(1,148)=24.48, p<.001), I-I life events (ΔR^2 = 0.03, F(1,148)=9.36, p=.003) and N-I life events (ΔR^2=

0.03 F(1,148) = 9.04, p= 0.01). Regression coefficients and standard errors are reported in Table 3.

As predicted, the level of I-D life events was more strongly associated with Time 3 depressive symptoms, whilst controlling for Time 1 depressive symptoms than I-I life events or N-I events. Every 1 standard deviation increase in I-D Events was associated with an increase in 2.10 points on the CDI at Time 3 (B =2.10, t(150)= 4.95, P<0.001, 95% CI [1.26 – 2.94]), whereas 1 SD increase in I-I events and N-I events was associated with an increase in 1.37 points (B= 1.37, t(150)= 3.06, P<0.01, 95% CI [0.49 – 2.26]) and 1.34 points (B= 1.34, t(150)= 3.01, P<0.01, 95% CI[0.46 – 2.22] on the CDI at Time 3 respectively. However, this interpretation should be treated with caution given that the overlap of the confidence intervals of the regression coefficients suggest statistical uncertainty with regard to whether the true size of the association between I-D events within the population is larger than that of I-I events and N-I events.

Table 3. Hierarchical Multiple Regression with Life Events Predicting Time 3 Depressive Symptoms.

Variable	B	SE_B	β	t	95% CI for B	R^2	Adj. R^2	F	Δ R^2	F Change
Interpersonal-Dependent Life Events										
Step 1						0.44	0.44	115.39***	0.44	115.39***
T1 CDI	4.70	0.44	0.66	10.74***	3.84 – 5.57					
Step 2						0.52	0.52	79.03***	0.08	24.48***
T1 CDI	4.14	0.42	0.58	9.80***	3.30 – 4.97					
T3 I-D ALEQ	2.10	0.42	0.29	4.95***	1.26 – 2.94					
Interpersonal-Independent Life Events										
Step 1						0.44	0.43	115.39***	0.44	115.39***
T1 CDI	4.70	0.44	0.66	10.74***	3.84 – 5.57					
Step 2						0.47	0.46	65.61***	0.03	9.36**
T1 CDI	4.32	0.44	0.61	9.73***	3.44 – 5.20					
T3 I-I ALEQ	1.37	0.45	0.19	3.06**	0.49 – 2.26					
Non-Interpersonal Life Events										
Step 1						0.44	0.43	115.39***	0.44	115.39***
T1 CDI	4.70	0.44	0.66	10.74***	3.84 – 5.57					
Step 2						0.47	0.46	65.33***	0.03	9.04**
T1 CDI	4.31	0.45	0.61	9.65***	3.42 – 5.19					
T3 N-I ALEQ	1.34	0.44	0.19	3.01**	0.46 –2.22					

*** = p<.001. ** = p<.01, *p<.05.

Note: B = unstandardized regression coefficient, β = standardized regression coefficient, SE_B = Standard Error of B, CDI = Children's Depression Inventory, I-D ALEQ interpersonal dependent subscale of Adolescent Life Events Questionnaire (ALEQ), I-I ALEQ= interpersonal-independent subscale of the ALEQ, N-I ALEQ = non-interpersonal dependent subscale of the ALEQ.

Predictor variables were standardized prior to entry into the regression equation.

Prospective Effects of Hassles on Time 3 Depressive Symptoms

The levels of hassles reported by adolescents in all three domains were found to statistically significantly predict Time 3 self-reported depressive Symptoms, whilst controlling for Time 1 depressive symptoms. The inclusion of hassles in the hierarchical multiple regression model (step 2) significantly and independently predicted T3 CDI for D-I hassles (ΔR^2= 0.05 F(1,129) = 15.37, p<0.001), I-I hassles (ΔR^2= 0.07= F(1,129) =21.74, p<0.001) and N-I hassles (ΔR^2=0.06 = F(1,128) =18.836, p<0.001). Regression coefficients and standard errors are reported in Table 4.

Contrary to predictions, the level of I-D hassles was not more strongly associated with Time 3 depressive symptoms, whilst controlling for Time 1 depressive symptoms, than I-I hassles or N-I hassles. Every 1 standard deviation increase in I-D hassles, I-I hassles and N-I hassles were associated with an increase in 1.75 points (B =1.75, t(129)= 3.92, P<0.001, 95% CI [0.87 – 2.63]), 2.05 points (B= 2.05, t(129)= 4.66, P<0.001, 95% CI [1.18 – 2.92]) and 1.92 points (B= 1.92, t(128)= 4.34, P<0.001, 95% CI[1.05 – 2.80] on the CDI at Time 3 respectively.

Table 4. Hierarchical Multiple Regression with Hassles Predicting Time 3 Depressive Symptoms.

Variable	B	SE_B	β	t	95% CI for B	R^2	Adj. R^2	F	Δ R^2	F Change
Interpersonal-Dependent Hassles										
Step 1						0.50	0.50	131.77***	0.50	131.77***
T1 CDI	5.16	0.45	0.71	11.48***	4.27 – 6.05					
Step 2						0.56	0.55	80.85***	0.05	15.37***
T1 CDI	4.64	0.45	0.64	10.40***	3.76 – 5.53					
T3 I-D CHS	1.75	0.45	0.24	3.92***	0.87 – 2.63					
Interpersonal-Independent Hassles										
Step 1						0.50	0.50	131.77***	0.50	131.77***
T1 CDI	5.16	0.45	0.71	11.48***	4.27 – 6.05					
Step 2						0.58	0.57	87.26***	0.07	21.74***
T1 CDI	4.53	0.44	0.62	10.32***	3.66 – 5.40					
T3 I-I CHS	2.05	0.44	0.28	4.66***	1.18 – 2.92					
Non-Interpersonal Hassles										
Step 1						0.50	0.50	131.27***	0.50	131.27***
T1 CDI	5.18	0.45	0.71	11.46***	4.28 – 6.07					
Step 2						0.57	0.56	84.13***	0.06	18.84***
T1 CDI	4.55	0.45	0.63	10.18***	3.67 – 5.44					

Variable	B	SE_B	β	t	95% CI for B	R^2	Adj. R^2	F	Δ R^2	F Change
T3 N-I CHS	1.92	0.44	0.27	4.34***	1.05 – 2.80					

*** = p<.001. ** = p<.01, *p<.05.

Note: B = unstandardized regression coefficient, β = standardized regression coefficient, SE_B = Standard Error of B, CDI = Children's Depression Inventory, I-D CHS = interpersonal dependent subscale of Child Hassles Scale (CHS), I-I = interpersonal independent subscale of the CHS, N-I = non-interpersonal subscale of the CHS. Predictor variables were standardized prior to entry into the regression equation.

3.4 Question 2: Test of the Stress-Reactivity Extension of the Response Styles Theory

The second aim was to test whether the association between stressors and depression was stronger for adolescents reporting high levels or rumination relative to distraction/problem solving or reporting high levels of co-rumination and to see whether rumination and co-rumination were more likely to lead to depression following certain types of stress more than others. Hierarchical multiple regression was used to test this hypothesis that the association between stressors (Time 3 life events or Time 2 hassles) and depressive symptoms would be stronger for those reporting higher levels of rumination relative to distraction/problem solving (response style ratio scores) and those reporting higher levels of co-rumination. The dependent variable was Time 3 CDI. Time 1 CDI (the covariate) was entered at Step 1 to control for baseline differences in depressive symptoms. Age and gender were not included as covariates since they were not significant predictors of Time 3 CDI in the previous regression analyses. Second, the stress variable and the response style variable were entered into the equation (Step 2). Finally, the interaction between the stress-variable and the response style variable was entered into the equation (Step 3). All variables within each step were entered simultaneously. Predictor variables were centred at their means prior to analyses to aid interpretation of the conditional effects (Hayes & Rockwood, 2017). The hierarchical multiple regression approach allows for a test of the stressor-response style interaction, above and beyond the contribution of Time 1 CDI and either the stressor or the response style alone. Separate regression analyses were performed for each stressor and for rumination and for co-rumination. Examining standardized residuals for all regression equations identified 3 possible outliers. One case was also identified to have a leverage value above the 0.5 cut-off that indicates the case has 'undue influence' on the model (Laerd Statistics, 2015). The regression analyses were re-run with the 3 possible outliers or high leverage case excluded. There was no difference in the pattern of results with or without possible outliers and therefore results reported here are with these cases included.

Response Style did not significantly moderate the association between stressors and Time 3 depressive symptoms for any of the stress variables. The inclusion of the interaction between stressors and CRSQ-Ratio in the model (step 3) did not statistically significantly add to the prediction of T3 depressive symptoms for I-D life events ($\Delta R^2 = 0.01$, $F(1,144) = 3.23$, $p=.074$), I-I life events ($\Delta R^2 = 0.00$, $F(1,144) =0.21$, $p=0.65$), N-I life events ($\Delta R^2 = 0.01$, $F(1,144) = 1.27$, $p=0.26$), I-D hassles ($\Delta R^2 =0.00$, $F(1,125) =0.11$, $p=0.74$), I-I hassles ($\Delta R^2 =0.00$, $F(1,125) =1.18$, $p=0.28$), or N-I hassles ($\Delta R^2 =0.01$, $F(1,124) =1.41$, $p=0.24$).

Similarly, co-rumination did not significantly moderate the association between stressors and Time 3 depressive symptoms for any of the stress variables. The inclusion of the interaction

between stressors and co-rumination in the model (step 3) did not statistically significantly add to the prediction of Time 3 depressive symptoms for I-D Life Events (ΔR^2 =0.00, F(1,138) =0.02, p=0.89), I-I life events (ΔR^2 =0.00, F(1,138) =0.53, p=0.47), N-I life events (ΔR^2 =0.00, F(1,138) =0.04, p=0.84), I-D hassles (ΔR^2 =0.00, F(1,119) = 0.03, p=0.86), I-I hassles (ΔR^2 =0.00, F(1,119) = 0.68, p=0.41), or N-I hassles (ΔR^2 =0.001, F(1,118) = 0.24, p=0.63). Regression coefficients and standard errors are reported in Appendix 5-8.

4. Discussion

The overall aim of the current study was to explore the role of response styles in the development of depression from a vulnerability-stress perspective, extending previous literature by examining different sub-types of stressors (interpersonal-dependent, interpersonal-independent and non-interpersonal) for 'daily hassles' as well as negative life events and examining the role of interpersonal and intrapersonal response styles (rumination relative to distraction and problem-solving and co-rumination).

The first aim was to explore whether levels of life events and hassles predicted increased depressive symptoms over time, and whether the strength of these relationships varied depending on the type and domain of stressor. Negative life events were found to significantly predict later depressive symptoms for all types of event, but results suggest that there was a stronger association between interpersonal-dependent events and prospective depressive symptoms than either interpersonal-independent events or non-interpersonal events. However, the 95% confidence intervals of the regression coefficients suggest that inferences regarding the relative strengths of the predictors should be treated with caution.

Few studies have examined different domains of stressful events in the prediction of prospective depressive symptoms in adolescents. Bastin et al., (2015) used the ALEQ to measure life events in a sample of adolescents and separated life events into interpersonal and non-interpersonal events. They found that higher levels of both domains of life events were associated with increased depressive symptom levels, but that interpersonal life events predicted greater increases in depressive symptoms across the 1-year follow-up than non-interpersonal life events. However, the current study goes one stage further by separating the interpersonal events into those that are dependent or independent of the individual. No other prospective study has further separated interpersonal life events into dependent or independent events to examine their main effects on depressive symptoms. However, the finding that dependent events are more strongly related to depressive episodes in a cross-sectional study with adolescents (Williamson et al., 1995) adds support to the current finding that Interpersonal-Dependent

events were more strongly predictive of later depressive symptoms than Interpersonal-Independent life events.

In summary, the results from the test of the main effects of stress on depression of the current study, supported by the findings of Bastin et al. (2015) and Williamson et al., (1995), suggest that interpersonal life events that are also dependent on the individual in some way may be particularly important in predicting depressive symptoms. As such, interventions in youth should aim to reduce all stressful events, but particularly the occurrence of dependent interpersonal stressors. Since dependent interpersonal events depend on the behaviour of the individual, these interventions could focus on reducing the behaviours or characteristics that contribute to increased dependent stressful events (e.g. Neuroticism, cognitive vulnerabilities, see stress-generation literature for review (Liu & Alloy, 2010).

In another extension of previous studies, we also examined the role of different domains of smaller, less significant events or 'daily hassles' in the prediction of depressive symptoms. Results suggested that all three domains of hassles had similar effects on follow-up depressive symptoms. To our knowledge, no other studies have explored different domains of daily hassles in the prediction of prospective depressive symptoms in adolescents. Since peer relationships become more important during adolescence (De Goede, Branje, Delsing, & Meeus, 2009), it was expected that stressors within this domain may have had a particularly strong influence on the development of depressive symptoms. However, for the current sample, the month-long, multi-wave assessment of hassles occurred just prior to their end of year academic assessments, which may have increased the salience of these non-interpersonal events, thereby increasing their effect on the depressive symptoms in the current sample of adolescents. Replication at different times of the academic year or in school holidays may be interesting to see whether the relative strengths of associations between the different domains of hassles and depressive symptoms differ over the school year.

The second aim of the study was to explore whether response-style (ratio of rumination relative to distraction and problem-solving) and co-rumination moderate the relationship between stressors and depression, examining different domains of life events and hassles. Turning first to response-style, the ratio of rumination relative to distraction/problem-solving was not found to moderate the relationships between depressive symptoms and life events in any domain. The literature regarding the life events x rumination interaction is mixed with several studies finding support for the interactive effect, (Abela & Hankin, 2011, Hankin, 2009; Skitch & Abela, 2008), but others failing to find a statistically significant moderating effect of rumination on the relationship between negative events and depressive symptoms (Abela et al., 2009; Schwartz &

Koenig, 1996; Bijttebier, et al., 2012; Cohen et al., 2014; Hamlat et al., 2015; Paredes & Zumalade, 2015).

However, all of the aforementioned studies explored stress as a unitary construct. Only one study separated life events both by interpersonal/non-interpersonal and dependence/independence and no study has explored these subgroups of events in hassles as well as life events. Stange et al. (2014) explored rumination in a vulnerability stress context in the prediction of depressive symptoms over nine months. As in the current study, they used the ALEQ and separated events into interpersonal-dependent, interpersonal-independent and non-interpersonal events. Stange et al., (2012) used a larger sample size than the current study (n=256) and did find a statistically significant interaction between rumination and dependent-interpersonal events, but not non-interpersonal events or independent-interpersonal events, in the prediction of depressive symptoms. However, the effect sizes for the significant rumination x dependent-interpersonal events interaction found in Stange et al. (2012) were small (R^2 change= 0.02) and comparable to the effect sizes of the same non-significant interaction in the current study (R^2 change = 0.01), suggesting the current study may have been underpowered to detect an effect of this size. The effect sizes for the non-significant interactions for interpersonal-independent and non-interpersonal events were also comparable in the current study (R^2 change < 0.01) compared to Stange et al., (2014; R^2 change < 0.01).

The current study extended previous research by examining the vulnerability-stress model of rumination for different domains of hassles as well as life events. No significant effect was found for response-style moderating the hassles-depression relationship, for any of the hassles subgroups. This is in contrast to other studies investigating rumination from a vulnerability-stress perspective for hassles measured as a unitary construct (Abela et al., 2012; Driscoll et al., 2009). The effect sizes reported by Driscoll et al., (2009) suggests the response style x hassles effect on depressive symptoms is small (R^2= 0.02). The effects found in the current study were not comparable with those found in Driscoll et al., (2009), with all three stress x hassles interactions explaining less than 1% additional variance in depressive symptoms. Both Driscoll et al., (2009) and Abela et al., (2012) took an idiographic approach to analysis, where changes in levels of hassles over the follow-up period were used to predict changes in depressive symptoms over the same follow-up. This allows levels of hassles at follow-up to be compared to the person's own previous level of hassles, rather than the group mean and higher stressor scores indicate an increased level of hassles, relative to previous levels, for the individual. This is compared to the current study where the mean levels of hassles was used to predict changes in depressive symptoms from baseline to follow up, where high hassles scores in the current study represent a high level of hassles relative to the group mean, which does not provide information about

whether the level of hassles was high or low for that individual. This differential way of representing stress may partly explain the contrasting results. Future research could explore rumination as a moderator of the hassles-depression relationship for different domains of hassles using multi-wave collection of hassles and depressive symptoms, to allow an idiographic analysis of the stressor-depressive symptom relationship in different domains and to test whether rumination exerts different effects for different domains.

With regard to inter-personal response-styles, co-rumination was also found not to moderate the stressor-depression relationship for any domain of the negative life events or daily hassles. This finding is consistent with other studies in adolescents (Bastin et al., 2015) and adults (Haggard et al., 2011) who also did not find that co-rumination moderated the stressor-depression association. However, both of these studies found significant gender x co-rumination x stressor effects, where co-rumination exerted differential effects on stressors for boys and girls, which would explain why the interaction effect had not been significant for the whole sample. In contrast to previous findings (e.g Rose, 2002), co-rumination was not significantly correlated with Time 1 or Time 3 depression, or Time 1 rumination in the current sample. Co-rumination has maladaptive components but is also associated with perceived friendship quality and relationship closeness (see Spendelow et al., 2017 for review). Rose (2002) proposed that the maladaptive component (repetitive, unproductive nature and focus on problems) of co-rumination can be explained by its overlap with rumination and in support of this, a moderate positive association between the two constructs has been found (Rose, 2002; Jose, Wilkins & Spendelow, 2012). Rose (2002) found that once rumination is controlled for, co-rumination has a negative association with depression, likely due to its beneficial association with the perceived friendship quality and relationship closeness that may have a protective effect with regards to depression. Given that co-rumination does not correlate with rumination in the current sample, it may be that the co-rumination measure in the context of the current sample was predominantly capturing the adaptive parts of co-rumination, which may explain why it was not found to exacerbate the effects of stress on depression in the current study.

A number of limitations of the current study should be noted. Firstly, self-report methods were used to measure all variables. Although shared method variance could be somewhat statistically accounted for by including baseline depressive symptoms as covariates in regression analyses, there are other issues to consider. With regards to self-report measurement of stressful life events, there is a risk that the reporting of events may be biased by mood-congruent recall, such that those with higher depressive symptoms would be more likely to recall more negative events than those with less depressive symptoms. Using a response scale that asked participants to report whether the event occurred or not in a given time period, should be less vulnerable to

cognitive biases than when participants are asked to rate the subjective impact of each event, or the frequency with which the events occurred. However, more objective measures of stress such as interview methods, or supplementing self-report with informant report, could be used to check that results replicate using alternative methods. Our measurement of daily hassles was one attempt to minimise the risk of reporting bias associated with retrospective, self-report checklist measures of negative events. By using repeated measurements of hassles over much shorter time periods (four assessments over four weeks) to create a mean weekly-hassles score, we hoped to reduce the impact of depressogenic cognitive biases and collect a fairly reliable estimate of hassles experienced on a weekly basis in the four weeks prior to the measurement of Time 3 depressive symptoms. The fact that the hassles measures were completed at a separate time to the completion of depressive symptom measures also reduces the risk that the recall of stressors is influenced by the participant's mood at the time of depressive symptoms measurement.

The current study also focused on the prediction of depressive symptoms in a community population. Future research may like to examine whether the results regarding stressors predicting depressive symptoms replicate in the prediction of future depressive episodes and in clinical samples.

The key limitation to the current research was the relatively small sample size. Due to higher than expected non-participation rates at Time 1 (mainly due to school absences, students being out of the classroom for alternative activities, and non-assent) our final sample size was smaller than we had aimed for. This may have reduced the power to detect small effects. Future studies could replicate the current study in a larger sample.

Final Summary

The current study is the first to examine response-style (ratio of rumination relative to distraction) and co-rumination as moderators of the stressor-depressive symptoms relationship for different domains of stressor for hassles as well as life events in a sample of early adolescents. All domains of life event and hassles were significantly associated with prospective depressive symptoms, but the association between interpersonal-dependent life events showed the strongest association with depressive symptoms. Response-style and co-rumination did not moderate the relationship between stressors and prospective depressive symptoms for any domain of life events or daily hassles in the current sample.

Findings from the current study do not provide support for the vulnerability-stress extension of the response styles theory, that hypothesizes that rumination as opposed to distraction/problem solving in response to or following negative events increases risk for depressive symptoms. Taking the findings of the current study together with the mixed findings of previous studies and small

effect sizes reported (Stange et al., 2014; Driscoll et al., 2009) suggests that the interactive effect of rumination and stressors in the prediction of prospective depressive symptoms in adolescents seems to be modest and the current sample size may have been too small to detect a small effect. However, given that multiple contributing factors have been identified in the development of depression, including biological, environmental and genetic factors (Avenevoli et al., 2008) and that rumination is theorised as one of several possible moderating factors of stress on depression (e.g. social support, self-criticism, dysfunctional attitudes; Abela & Hankin, 2008; Wang, Cai, Qian & Peng, 2014) the effect of any single predictor (in this case the interacting effect of stress and rumination) is likely to be modest. Future research into rumination in a stress-vulnerability context could utilise an idiographic approach to analysis, include measurement of clinical episodes of depression and use clinical or high-risk samples of adolescents.

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6. Appendices

Appendix 1: Self-report measures collected at each time-point in larger project from which this study is drawn.

Time Point 1

Depressive symptoms. The Children's Depression Inventory (CDI; Kovacs, 2003).

Irritability. The Affective Reactivity Index (ARI; Stringaris, Goodman et al. 2012).

Anxiety Symptoms. The Multidimensional Anxiety Scale for Children Second Addition (MASC; March, Parker et al. 1997).

Depressive-Rumination: The Children's Response Styles Questionnaire (CRSQ; Abela, Brozina et al. 2002).

Co-rumination. The Co-rumination Questionnaire (CRQ; Rose 2002).

Anger- Rumination. The Children's Anger Rumination Scale (CARS; adapted by Repper 2006), from (Sukhodolsky, Golub et al. 2001).

Cognitive vulnerability for depression. The Adolescent Cognitive Style Questionnaire – Modified (ACSQ-M; Alloy et al., 2012).

Time Point 2 – the following measures of hassles were completed every week for 4 weeks, starting at 5 months following baseline.

Child Hassles and Uplifts Scale (Kanner, 1987)

Brief Adolescent Life Events Scale (Shahar, Henrich, Reiner & Little, 2003).

Time Point 3, completed at 6 months following baseline.

Life Events. The *Adolescent Life Events Questionnaire* (ALEQ; Hankin and Abramson 2002).

Depressive symptoms. The Children's Depression Inventory (CDI; Kovacs, 2003).

Irritability. The Affective Reactivity Index (ARI; Stringaris, Goodman et al. 2012).

Appendix 2: Letter confirming ethical approval of study.

Research Ethics
Office

Franklin Wilkins Building
5.9 Waterloo Bridge Wing
Waterloo Road
London SE19NH
Telephone 020 7848 4020/4070/4077
reo@kcl.ac.uk

KING'S College LONDON

Hannah Brown

2 October 2015

Dear Hannah,

Study Title: Cognitive vulnerabilities for depression in stress generation and stress reactivity in adolescence

Study Reference: HR-15/16-1919

I am pleased to inform you that full approval for your project has been granted by the Psychiatry, Nursing and Midwifery Research Ethics Subcommittee

Please ensure that you follow all relevant guidance as laid out in the King's College London Guidelines on Good Practice in Academic Research (http://www.kcl.ac.uk/college/policyzone/index.php?id=247).

For your information, ethical approval is granted until 2nd October 2018. If you need approval beyond this point, you will need to apply for an extension at least two weeks before this. You will be required to explain the reasons for the extension. However, you will not need to submit a full re-application unless the protocol has changed. If you have been granted approval for only 12 months, you will not be sent a reminder when it is due to lapse.

Ethical approval is required to cover the data-collection phase of the study. This will be until the date specified in this letter. However, you do not need ethical approval to cover subsequent data analysis or publication of the results.

For secondary data-analysis, ethical approval is applicable to the data that is sensitive or identifies participants.

Approval is applicable to period in which such data is accessed or evaluated.

Please note you are required to adhere to all research data/records management and storage procedures agreed to as part of your application. This will be expected even after the completion of the study.

If you do not start the project within three months of this letter, please contact the Research Ethics Office.

Please note that you will be required to obtain approval to modify the study. This also encompasses extensions to periods of approval. Please refer to the URL below for further guidance about the process:

http://www.kcl.ac.uk/innovation/research/support/ethics/applications/modifications.aspx

Please would you also note that we may, for the purposes of audit, contact you from time to time to ascertain the status of your research.

If you have any query about any aspect of this ethical approval, please contact the Research Ethics Office:

(http://www.kcl.ac.uk/innovation/research/support/ethics/contact.aspx)

We wish you every success with this work.

Yours sincerely,

James Patterson - Senior Research Ethics Officer

For and on behalf of

Professor Gareth Barker, Chair of the Psychiatry, Nursing and Midwifery Research Ethics Subcommittee

Cc: Eleanor Leigh

Appendix 3: Comparing the ethnic and gender distribution of study sample to school population.

Ethnicity	School Register		Study Sample	
	N	%	N	%
Asian	15	6.20	11	6.67
Black	137	56.61	90	54.55
White	49	20.25	31	18.79
Mixed	29	11.98	24	14.55
Other	12	4.96	8	4.85
Total	242	100	164	99.39
Gender				
Males	142	58.44	94	56.97
Females	101	41.56	71	43.03

Appendix 4: Summary of assumptions analyses for all regression equations.

Regression Equation	Independence of Observations (DW score close to 2)	Linearityy	Homocedacity	No multicolli-nearity (r <0.7, Tolerance > 0.1)	No standardized Residuals >3	No medium (0.2<LEV<0.5) or high risk leverage values (LEV >0.5)	No highly infuential points (CD<1).	Normal distribution of residuals
I-D ALEQ predicting T3 CDI	Yes	Yes	Yes	Yes		No	Yes	Yes	Yes
I-I ALEQ predicting T3 CDI	Yes	Yes	Yes	Yes		No	Yes	Yes	Yes
N-I ALEQ predicting T3CDI	Yes	Yes	Yes	Yes		No	Yes	Yes	Yes
I-D CHS predicting T3 CDI	Yes	Yes	Yes	Yes		No	Yes	Yes	Yes
I-I CHS predicting T3 CDI	Yes	Yes	Yes	Yes		No	Yes	Yes	Yes
N-I CHS predicting T3CDI	Yes	Yes	Yes	Yes		No	Yes	Yes	Yes
I-D ALEQ x Response Style	Yes	Yes	Yes	Yes		No	No	Yes	Yes
I-I ALEQ x Response Style	Yes	Yes	Yes	Yes		No	No	Yes	Yes

N-I ALEQ x Response Style	Yes	Yes	Yes	Yes	No	No	Yes	Yes
I-D CHS x Response Style	Yes	Yes	yes	Yes	No	No	No	Yes
I-I CHS x Response Style	Yes	Yes	yes	Yes	No	No	Yes	Yes
N-I CHS x Response Style	Yes	Yes	yes	Yes	No	No	Yes	Yes
I-D ALEQ x Co-Rumination	Yes	Yes	Yes	Yes	No	yes	Yes	Yes
I-I ALEQ x Co-Rumination	Yes	Yes	Yes	Yes	No	No	Yes	Yes
N-I ALEQ x Co-Rumination	Yes	Yes	Yes	Yes	No	yes	Yes	Yes
I-D CHS x Co-Rumination	Yes	Yes	Yes	Yes	No	No	Yes	Yes
I-I CHS x Co-Rumination	Yes	Yes	Yes	Yes	No	No	Yes	Yes
N-I CHS x Co-Rumination	Yes	Yes	Yes	Yes	No	No	Yes	Yes

Appendix 5: Hierarchical Multiple Regression Analyses with the interaction of Response Styles and Life Events Predicting Time 3 Depressive Symptoms.

Variable	B	SE_B	β	t	95% CI for B	R^2	Adj. R^2	F	Δ R^2	F Change
Interpersonal Dependent Life Events										
Step 1						0.43	0.43	110.43***	0.43	110.43***
T1 CDI	0.55	0.05	0.66	10.51***	0.45 - 0.65					
Step 2						0.51	0.50	50.58***	0.08	12.22***
T1 CDI	0.53	0.07	0.63	7.64***	0.39 – 0.66					
CRSQ-Ratio	-0.97	1.09	-0.07	-0.89	-3.13 – 1.19					
T3 I-D ALEQ	0.39	0.08	0.29	4.81***	0.23 – 0.55					
Step 3						0.52	0.51	39.33***	0.01	3.23
T1 CDI	0.52	0.07	0.62	7.57***	0.38 – 0.65					
CRSQ-Ratio	-0.52	1.11	-0.04	-0.47	-2.72 – 1.68					
T3 I-D ALEQ	0.38	0.08	0.28	4.68***	0.22 – 0.54					
CRSQ-Ratio x I-D ALEQ	0.36	0.20	0.11	1.80	-0.04 – 0.76					
Interpersonal Independent Life Events										
Step 1						0.43	0.43	110.43***	0.43	110.43***
T1 CDI	0.55	0.05	0.66	10.51***	0.45 - 0.65					
Step 2						0.47	0.46	42.215***	0.04	5.06**
T1 CDI	0.56	0.07	0.67	7.80***	0.42 – 0.70					
CRSQ-Ratio	-1.24	1.14	-0.09	-1.09	-3.50 – 1.02					

Variable	B	SE_B	β	t	95% CI for B	R^2	Adj. R^2	F	Δ R^2	F Change
T3 I-I ALE	0.69	0.23	0.19	2.99**	0.23 – 1.15					
Step 3						0.47	0.45	31.3***	0.01	3.23
T1 CDI	0.56	0.07	0.67	7.77***	0.42-0.70					
CRSQ-Ratio	-1.24	1.15	-0.09	-1.08	-3.50 – 1.03					
T3 I-I ALEQ	0.70	0.23	0.19	3.01**	0.24 – 1.16					
CRSQ-Ratio x I-I ALEQ	-0.22	0.47	-0.03	-0.46	-1.15 – 0.72					
Non-Interpersonal Life Events										
Step 1						0.43	0.43	110.43***	0.43	110.43***
T1 CDI	0.55	0.05	0.66	10.51***	0.45 - 0.65					
Step 2						0.47	0.45	41.99***	0.04	4.87**
T1 CDI	0.56	0.07	0.66	7.73***	0.41 - 0.70					
CRSQ-Ratio	-1.22	1.14	-0.09	-1.07	-3.48 – 1.04					
T3 N-I ALEQ	0.50	0.17	0.19	2.92**	0.16 – 0.83					
Step 3						0.47	0.46	31.87***	0.01	1.27
T1 CDI	0.54	0.07	0.64	7.23***	0.39 – 0.68					
CRSQ-Ratio	-0.97	1.16	0.07	-0.84	-3.27 – 1.33					
T3 N-I ALEQ	0.52	0.17	0.19	3.04**	0.18 – 0.86					
CRSQ-Ratio x N-I ALEQ	0.44	0.39	0.07	1.13	-0.33 – 1.22					

*** = p<.001. ** = p<.01, *p<.05.

Note: B = unstandardized regression coefficient, β = standardized regression coefficient, SE_B = Standard Error of B, CDI = Children's Depression Inventory, I-D ALEQ Interpersonal Dependent Subscale of Adolescent Life Events Questionnaire (ALEQ), I-I ALEQ= Interpersonal Independent Subscale of the ALEQ, N-I ALEQ = Non-Interpersonal Dependent Subscale of the ALEQ.

Appendix 6: Hierarchical Multiple Regression Analyses with the interaction of Response Styles and Daily Hassles Predicting Time 3 Depressive Symptoms.

Variable	B	SE_B	β	t	95% CI for B	R^2	Adj. R^2	F	Δ R^2	F Change
Interpersonal Dependent Hassles										
Step 1						0.50	0.49	126.01***	0.50	126.01***
T1 CDI	0.60	0.05	0.70	11.23***	0.50 - 0.71					
Step 2						0.57	0.50	51.09***	0.05	7.37***
T1 CDI	0.56	0.07	0.66	7.58***	0.42 – 0.71					
CRSQ-Ratio	-0.49	1.34	-0.03	-0.36	-3.14 – 2.17					
T3 I-D CHS	1.63	0.42	0.24	3.84***	0.79 – 2.46					
Step 3						0.57	0.51	38.08***	0.00	0.11
T1 CDI	0.56	0.08	0.66	7.53***	0.41– 0.71					
CRSQ-Ratio	-0.58	1.37	-0.04	-0.42	-3.29 – 2.14					
T3 I-D CHS	1.63	0.43	0.24	3.83***	0.79 – 2.47					
CRSQ-Ratio x I-D CHS	0.24	0.71	0.02	0.34	-1.16 – 1.63					
Interpersonal Independent Hassles										
Step 1						0.50	0.49	126.01***	0.50	126.01***
T1 CDI	0.60	0.05	0.70	11.23***	0.50 - 0.71					
Step 2						0.57	0.56	55.09***	0.07	10.39***
T1 CDI	0.52	0.07	0.61	7.02***	0.37 – 0.67					
CRSQ-Ratio	0.25	1.31	0.02	0.19	-2.35 – 2.84					

Variable	B	SE_B	β	t	95% CI for B	R^2	Adj. R^2	F	Δ R^2	F Change
T3 I-I CHS	1.36	0.30	0.28	4.56***	0.77 – 1.95					
Step 3						0.57	0.56	41.67***	0.00	1.18
T1 CDI	0.51	0.08	0.60	6.81***	0.36-0.66					
CRSQ-Ratio	0.41	1.32	0.03	0.31	-2.20 – 3.02					
T3 I-I CHS	1.40	0.30	0.29	4.67***	0.81 – 1.99					
CRSQ-Ratio x I-I CHS	0.87	0.81	0.07	1.09	-0.72 – 2.47					
Non-Interpersonal Hassles										
Step 1						0.50	0.49	125.49***	0.50	125.49***
T1 CDI	0.60	0.05	0.71	11.20***	0.50 - 0.71					
Step 2						0.56	0.55	52.98***	0.06	8.91***
T1 CDI	0.54	0.08	0.63	7.24***	0.39 - 0.69					
CRSQ-Ratio	-0.15	1.33	-0.01	-1.11	-2.78 – 2.47					
T3 N-I CHS	0.83	0.20	0.26	4.22***	0.44 – 1.22					
Step 3						0.57	0.55	40.22***	0.01	1.41
T1 CDI	0.53	0.08	0.62	7.07***	0.38 – 0.68					
CRSQ-Ratio	-0.40	1.34	-0.03	-0.30	-3.06 – 2.25					
T3 N-I CHS	0.89	0.20	0.28	4.39***	0.49 – 1.29					
CRSQ-Ratio x N-I CHS	0.53	0.45	0.08	1.19	-0.35 – 1.42					

*** = p<.001. ** = p<.01, *p<.05.

Note: B = unstandardized regression coefficient, β = standardized regression coefficient, SE_B = Standard Error of B, CDI = Children's Depression Inventory, I-D CHS = Interpersonal Dependent Subscale of Child Hassles Scale (CHS), I-I = Interpersonal Independent Subscale of the CHS, N-I = Non-Interpersonal Subscale of the CHS.

Appendix 7: Hierarchical Multiple Regression Analyses with the interaction of Co-rumination and Life Events Predicting Time 3 Depressive Symptoms.

Variable	B	SE_B	β	t	95% CI for B	R^2	Adj. R^2	F	Δ R^2	F Change
Interpersonal Dependent Life Events										
Step 1						0.43	0.43	106.14***	0.43	106.14***
T1 CDI	0.55	0.05	0.66	10.30***	0.44 - 0.66					
Step 2						0.51	0.50	51.16***	0.10	13.93***
T1 CDI	0.50	0.05	0.59	9.71***	0.39 – 0.60					
Co-Rum	-0.81	0.53	-0.09	-1.53	-1.85 – 0.23					
T3 I-D ALEQ	0.42	0.08	0.30	5.11***	0.236– 0.58					
Step 3						0.52	0.51	38.10***	0.00	0.02
T1 CDI	0.48	0.05	0.59	9.64***	0.39 – 0.60					
Co-Rum	-0.81	0.53	-0.09	-1.53	-1.86 – 0.24					
T3 I-D ALEQ	0.42	0.08	0.31	5.10***	0.26 – 0.59					
Co-Rum x I-D ALEQ	0.02	0.11	0.01	0.14	-0.20 – 0.23					
Interpersonal Independent Life Events										
Step 1						0.43	0.43	106.14***	0.43	106.14***
T1 CDI	0.55	0.05	0.66	10.30***	0.44 - 0.66					
Step 2						0.47	0.46	41.62***	0.04	5.77**
T1 CDI	0.51	0.05	0.61	9.54***	0.41 – 0.62					
Co-Rum	-0.75	0.56	-0.08	-1.35	-1.85 – 0.35					

Variable	B	SE_B	β	t	95% CI for B	R^2	Adj. R^2	F	Δ R^2	F Change
T3 I-I ALEQ	0.74	0.23	0.20	3.16**	0.28 – 1.20					
Step 3						0.48	0.46	31.24***	0.00	0.53
T1 CDI	0.52	0.06	0.62	9.49***	0.41 – 0.63					
Co-Rum	-0.76	0.56	-0.09	-1.37	-1.860 – 0.34					
T3 I-I ALEQ	0.71	0.24	0.20	3.03**	0.25 – 1.18					
Co-Rum x I-I ALEQ	-0.22	0.30	-0.05	-0.72	-0.81 – 0.38					
Non-Interpersonal Life Events										
Step 1						0.43	0.43	106.14***	0.43	106.14***
T1 CDI	0.55	0.05	0.66	10.30***	0.44 - 0.66					
Step 2						0.48	0.47	42.16***	0.05	6.23**
T1 CDI	0.51	0.05	0.61	9.54***	0.41 - 0.62					
Co-Rum	-0.92	0.56	-0.10	-1.65	-2.02 – 1.18					
T3 N-I ALEQ	0.58	0.18	0.21	3.30**	0.23 – 0.92					
Step 3						0.48	0.46	31.41***	0.00	0.04
T1 CDI	0.51	0.05	0.61	9.51***	0.41 – 0.62					
Co-Rum	-0.92	0.56	-0.10	-1.64	-2.02 – 0.19					
T3 N-I ALEQ	0.58	0.18	0.21	3.30**	0.23 – 0.93					
Co-Rum x N-I ALEQ	0.04	0.22	-0.01	-0.20	-0.47 – 0.38					

*** = p<.001. ** = p<.01, *p<.05.

Note: B = unstandardized regression coefficient, β = standardized regression coefficient, SE_B = Standard Error of B, CDI = Children's Depression Inventory, Co-Rum = Co-Rumination, I-D ALEQ Interpersonal Dependent Subscale of Adolescent Life Events Questionnaire (ALEQ), I-I ALEQ= Interpersonal Independent Subscale of the ALEQ, N-I ALEQ = Non-Interpersonal Dependent Subscale of the ALEQ.

Appendix 8: Hierarchical Multiple Regression Analyses with the interaction of Co-rumination and Daily Hassles Predicting Time 3 Depressive Symptoms.

Variable	B	SE_B	β	t	95% CI for B	R^2	Adj. R^2	F	Δ R^2	F Change
Interpersonal Dependent Hassles										
Step 1						0.50	0.50	121.43***	0.50	121.43***
T1 CDI	0.61	0.06	0.71	11.02***	0.50 - 0.71					
Step 2						0.57	0.56	52.58***	0.07	9.60***
T1 CDI	0.55	0.05	0.65	10.32***	0.45 – 0.66					
Co-Rum	-1.09	0.55	-0.12	-1.98	-2.18 – 0.00					
T3 I-D CHS	1.74	0.43	0.25	4.04***	0.89 – 2.60					
Step 3						0.57	0.55	39.12***	0.00	0.03
T1 CDI	0.55	0.06	0.64	10.05***	0.44– 0.66					
Co-Rum	-1.07	0.57	-0.12	-1.88	-2.19 – 0.06					
T3 I-D CHS	1.74	0.43	0.25	4.03***	0.89 – 2.60					
Co-Rum x I-D CHS	-0.09	0.53	-0.01	-0.17	-1.14– 0.95					
Interpersonal Independent Hassles										
Step 1						0.50	0.50	121.43***	0.50	121.43***
T1 CDI	0.61	0.06	0.71	11.02***	0.50 - 0.71					
Step 2						0.59	0.58	58.38***	0.10	13.95***
T1 CDI	0.54	0.05	0.63	10.30***	0.43 – 0.64					
Co-Rum	-1.37	0.54	-0.15	-2.54*	-2.44 – 0.30					

Variable	B	SE_B	β	t	95% CI for B	R^2	Adj. R^2	F	Δ R^2	F Change
T3 I-I CHS	1.51	0.30	0.31	4.99***	0.91 – 2.11					
Step 3						0.60	0.58	43.83***	0.00	0.68
T1 CDI	0.54	0.05	0.62	10.20***	0.43 – 0.64					
Co-Rum	-1.32	0.55	-0.14	-2.42*	-2.39 – -0.24					
T3 I-I CHS	1.55	0.31	0.32	5.05***	0.94 – 2.16					
Co-Rum x I-I CHS	-0.28	0.35	-0.05	-0.82	-0.97 – 0.40					
Non-Interpersonal Hassles										
Step 1						0.50	0.50	120.94***	0.50	120.94***
T1 CDI	0.61	0.06	0.71	11.00***	0.50 - 0.72					
Step 2						0.59	0.58	57.49***	0.09	13.39***
T1 CDI	0.54	0.05	0.63	10.28***	0.434 - 0.65					
Co-Rum	-1.32	0.54	-0.15	-2.44*	-2.39 – -0.25					
T3 N-I CHS	0.97	0.20	0.30	4.88***	0.58 – 1.37					
Step 3						0.59	0.58	42.90***	0.00	0.24
T1 CDI	0.54	0.05	0.63	10.09***	0.43 – 0.64					
Co-Rum	-1.29	0.55	-0.14	-2.36	-0.02 – 2.37					
T3 N-I CHS	0.97	0.20	0.30	4.85***	0.58 – 1.37					
Co-Rum x N-I CHS	-0.11	0.22	-0.03	-0.49	-0.55 – 0.33					

*** = p<.001. ** = p<.01, *p<.05.

Note: B = unstandardized regression coefficient, β = standardized regression coefficient, SE_B = Standard Error of B, CDI = Children's Depression Inventory, Co-Rum = Co-Rumination, I-D CHS = Interpersonal Dependent Subscale of Child Hassles Scale (CHS), I-I = Interpersonal Independent Subscale of the CHS, N-I = Non-Interpersonal Subscale of the CHS